National Research Council Canada
Conseil national de recherches Canada

Division of Energy
Division de l'énergie

Heat Pump Program
Programme des pompes de chaleur

Monitoring of a Heat Pump to Energy Recovery and Process Temperature Control

Clearwater Lobsters Ltd. and A. Orlic & Associates Ltd.

March 1986

Canada

NRCC No. 27191

87-04565/

This report summarizes work carried out under contract to the Division of Energy, National Research Council of Canada. It has been published in accordance with the policy of the National Research Council of Canada of making information on energy research and development available to all interested groups. Publication by the National Research Council of Canada does not signify that the contents necessarily reflect the views or policies of the National Research Council of Canada, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. Furthermore, no warranty or representation is made with respect to the accuracy or completeness of the information contained in this report. This report is reproduced here from camera-ready copy prepared by the contractor. The abstract was translated by the National Research Council of Canada.

This project was supported by the Federal Panel on Energy R&D (PERD).

Copyright 1987 by
National Research Council of Canada

Permission is granted to quote short excerpts and to reproduce figures and tables from this report, provided that the source of such material is fully acknowledged.

Copies of this and other publications of the Division of Energy may be obtained by mailing the appropriate remittance (a Bank, Express, or Post Office Money Order, or a cheque made payable to the Receiver General for Canada, credit NRC) to

Publication Sales and Distribution Office
National Research Council of Canada
Ottawa, Ontario
K1A 0R6

Price: Free

Le présent rapport constitue un résumé des travaux effectués à contrat par la Division de l'énergie, Conseil national de recherches du Canada. Sa publication est conforme à la politique du Conseil national de recherches du Canada qui est de diffuser l'information disponible sur la recherche et le développement énergétiques auprès de tous les groupes intéressés. Son contenu n'exprime pas nécessairement les opinions ou politiques du Conseil national de recherches du Canada et la mention de marques ou produits commerciaux ne doit pas être considérée comme une approbation ou une recommandation d'utilisation. De plus, aucune garantie ni représentation ne peut être faite quant à l'exactitude ou à l'intégralité du contenu du rapport, qui a été reproduit à partir d'une copie prête à l'impression préparée par le sous-traitant. Le résumé a été traduit par le Conseil national de recherches du Canada.

Ce projet a reçu l'appui du Comité (fédéral interministériel) de la recherche et du développement energétiques (CRDE).

Copyright 1987 par
Conseil national de recherches du Canada

De courtes citations et la reproduction de figures et tableaux du présent rapport sont autorisées sous réserve que la source en soit clairement mentionée.

Des exemplaires du rapport et d'autres publications de la Division de l'énergie peuvent être obtenus par courrier sur le paiement d'avance des droits requis (règlement par mandat de banque, mandat-exprès, mandat-poste ou chèque payables au Receveur général du Canada, crédit du CNRC) à l'adresse suivante:

Bureau de vente et diffusion des publications
Conseil national de recherches du Canada
Ottawa (Ontario)
K1A 0R6

Prix unitaire: Gratuit

Report On

Monitoring of a Heat Pump to Energy Recovery and Process Temperature Control

at:
Clearwater Lobsters Ltd.
Clark's Harbour
Yarmouth County, Nova Scotia

Submitted to:
Supply and Services Canada, Hull, Quebec

on behalf of:
National Research Council Canada
Division of Energy, Ottawa

DSS File — 24SR.31926 — 3 — 3072

Submitted by:
Clearwater Lobsters Ltd., Halifax, Nova Scotia

in association with:
A. Orlic & Associates Ltd. Halifax, Nova Scotia

Halifax, March 1986

TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY ix
RÉSUMÉ POUR LA DIRECTION xi
INTRODUCTION xiii
INTRODUCTION xv
SYNOPSIS xvii
RÉSUMÉ xxvii

1.0 OCEAN SOURCE HEAT PUMP SYSTEM 1
- 1.1 Background 1
- 1.2 Facilities and System 8
- 1.3 Design Conditions and Projected Performance . 10
- 1.4 Monitoring Program 18
- 1.5 Analytical Monitored Results 20
- 1.6 Operational Monitored Results 59
- 1.7 Evaluation of Performance and Results 72

2.0 FACILITIES PERFORMANCE 83
- 2.1 Product Volumes and Rates 83
- 2.2 Electrical Energy Usage 84
- 2.3 Biological Performance 86

3.0 ECONOMIC EVALUATION 90

APPENDIX 'A'; OCEAN SOURCE HEAT PUMP SYSTEM - REFERENCES MATERIAL 93
- Equipment List and Abbreviations Used 95

APPENDIX 'B'; OCEAN SOURCE HEAT PUMP SYSTEM - DESIGN CONDITIONS 97

APPENDIX 'C'; EQUIPMENT PERFORMANCE SPECIFICATIONS . . . 113
- C.1 Heat Pump 114
- C.2 Cold Seawater Plate Heat Exchanger. 127
- C.3 Waste Heat Plate Heat Exchanger 129
- C.4 Warm Seawater Plate Heat Exchanger 132
- C.5 Warm Seawater Plate Heat Exchanger 135
- C.6 Seawater Supply Pumps 137
- C.7 Seawater Circulating Pumps 139

TABLE OF CONTENTS (Cont'd)

PAGE

C.8 Waste Seawater Pumps 141
C.9 Hot Water Circulating Pumps 143
C.10 Seawater Return Pumps 145

APPENDIX 'D'; MONITORING PROGRAM TERMS OF REFERENCE . . 147

APPENDIX 'E'; MONITORING INSTRUMENTATION 153
E.1 Temperature Sensors and Transmitters 154
E.2 Pressure Sensors and Transmitters 160
E.3 Flow Rates Sensors and Transmitters 161
E.4 Differential Pressure Sensors and Transmitters 167
E.5 Electrical Loads Sensors and Transmitters . . 173
E.6 Data Acquisition and System Control Equipment 179

APPENDIX 'F'; MONITORING INSTRUMENTATION INSTALLATION OF DETAILS 183

APPENDIX 'G'; MONITORING PROGRAM FLOW CHARTS 187

APPENDIX 'H'; MONITORED DATA AND PERFORMANCE RESULTS . . 199

APPENDIX 'I'; FACILITY DATA 273

APPENDIX J-1; BIOLOGICAL REPORTS ON HOLDING OF LIVE LOBSTER IN COLD SEAWATER ENVIRONMENT . . 279

APPENDIX 'K'; RECOMMENDED MODIFICATIONS FOR WARM/COLD SEAWATER EXPERIMENTAL LABORATORY 287

APPENDIX 'L'; PHOTOGRAPHS OF FACILITY 291

LIST OF FIGURES

PAGE

1.1 Ocean Source Heat Pump Proposed Monitoring Conditions . . . . facing 10
1.2 Project Average Yearly Ocean Source Seawater Temperature Profile 12
1.3 Projected Average Yearly Operating Conditions for Heat Pump System 14
1.4 Average Daily Ocean Source Seawater Supply Temperature (T1) 22
1.5 Average Daily Temperatures of Ocean Source Seawater Supply 24
1.6 Average Daily Temperatures at C.S.W.P.H.E. 26
1.7 Average Daily Approach Temperatures at C.S.W.P.H.E. 27
1.8 Average Daily Temperatures at H.P.E. 29
1.9 Average Daily Temperatures of Recirculated Cold Seawater 30
1.10 Average Daily Temperatures at C.S.W.R.R. 31
1.11 Average Daily Temperatures at H.P.C. 33
1.12 Average Daily Temperatures at W.H.P.H.E. 34
1.13 Average Daily Flow Rates 36
1.14 Average Daily Flow Rates of Recirculated Fresh Water 37
1.15 Average Daily Flow Rates of Ocean Source Seawater Supply to W.S.W.D.L.P. 38
1.16 Average Daily Operating Pressures 40
1.17 Average Daily Pressure Drop Across C.S.W.P.H.E. . 41
1.18 Average Daily Pressure Drop Across H.P.E. 43
1.19 Average Daily Pressure Drop Across H.P.C. 44
1.20 Average Daily Electrical Loads 46
1.21 Average Daily Electrical Loads 47
1.22 Average Daily Thermal Energy Extracted from Ocean Source Seawater Supply 48
1.23 Average Daily Thermal Energy Output by Heat Pump . 51
1.24 Average Daily Relationship of Energy Supply/Demand 52
1.25 Average Daily Relationship of Energy Supply/Demand 53
1.26 Average Daily Coefficient of Performance (HT4/KWZ) of Heat Pump 54
1.27 Average Daily Thermal Energy Supply Relationship . 55
1.28 Average Daily Thermal Loads 57

LIST OF FIGURES(Cont'd)

PAGE

1.29 Average Daily Relationship of Thermal Energy Balance Variation 58
1.30 Effect of Seaweed Influx and Marine Life Growth on the Differential Pressure Across Ambient Side of Cold Seawater Plate Heat Exchanger 62
1.31 Effect of Biological Growth on the Differential Pressure Across Waste Seawater Side of Cold Seawater Plate Heat Exchanger 64
1.32 Comparison of Heat Pump Systems 92
A.1 Site Plan . . . . facing blank 94
A.2 Facilities and Equipment Layout. . . . following Fig. A.1
A.3 Heat Pump System Flow Diagram . . . . following Fig. A.2
F.1 Monitoring Systems Wiring Diagram . . facing blank 184
F.2 Monitoring Equipment Installation . . following Fig. F.1
F.3 Monitoring Equipment Installation . . following Fig. F.2
F.4 Wiring Details for Power Load Transducers 185
G.1 Heat Pump Monitoring System Block 188
G.2 Main Program Segment 189
G.3 Hourly System Measurements 190
G.4 Soft Key Measurement Routine 191
G.5 Data Evaluation Routine 192
G.6 3497 Measurement Subroutine 193
G.7 Data Edit Subroutine - Graphical 194
G.8 Final Plots Subroutines - Data only 195
G.9 Data Calculations and Output 196
G.10 Shutdown Routine 197
J-1 Temperature of Ambient and Heated Seawater in Warm Seawater Laboratory Experiments 286

LIST OF TABLES

1-1 Comparison of Design and Monitored Performance Conditions 74
2-1 Average Weekly Monitored Conditions of 42 Experimental Trays 89
B-1 Pressures and Differential Pressures 98
B-2 Temperatures 99

LIST OF TABLES(Cont'd)

PAGE

B-3 Flow Rates 101
B-4 Electrical Loads 102
B-5 Differential Temperatures 103
B-6 Heat Transfer Rates 105
B-7 Electrical Energy Costs 106
B-8 Performance Rates 107
B-9 Equations Used in Calculations 108
B-10 Constants Used in Calculations 109
B-11 Cost of Thermal Energy Generated by Combustion of No. 2 Fuel Oil 110
B-12 Capital Cost for Heat Pump Installation 111
B-13 Comparison of Boiler Chiller Combination vs. Heat Pump System 112
D-1 Statement of Work 148
D-2 Pressures 149
D-3 Temperatures 150
D-4 Flow Rates 151
D-5 Electrical Loads 152
H-1 to H-49 Monitored Data for Weekly Periods from April 21,1985 to March 21, 1986 200
H-50 to H-97 Calculated Performance Results for Weekly Period from April 27, 1985 to March 21, 1986 249-272
I-1 Weekly Product Inventory - May 3, 1985 to December 6, 1985 274
I-2 Weekly Product Inventory of D.L.P's - May 3, 1985 to December 6, 1985 275
I-3 Weekly Product Inventory of Tankhouse and Reservoir - May 3, 1985 to December 6, 1985 . . 276
I-4 Electrical Energy Usage and Costs for 12 month period Ending November 28, 1985 277

EXECUTIVE SUMMARY

The objective of this study is to report on the development and implementation of a heat pump monitoring program detailing the application and adaptation of standard commercial heat pump equipment for the extraction and use of thermal energy from ocean source seawater along Canada's Atlantic Coast. The specific application was a lobster holding facility owned by Clearwater Lobsters Limited of Halifax, Nova Scotia.

Examination of the data has indicated: the heat pump system can extract and use thermal energy, at or near, initial design conditions; enabled the lobsters to be held at consistently lower temperatures which improved product quality and reduced shrinkage; identified influx of seawater debris, marine growth, and dryland pound heat gain as the only major problems and indicated further biological factors that require further testing and investigation.

The information gathered from the monitoring study indicates that heat pump systems can be adapted to extract and utilize thermal energy from ocean source seawater. It should be noted that the heat pump system will be more economically attractive if there is also a use for the cold seawater (from which the thermal energy has been extracted), as is the case with the lobster facility.

The total cost of the system, including the building and mechanical electrical components specifically related to the heat pump was $481,840.00. The simple payment based on an estimated annual saving of $163,900 will be 2.9 years.

Clearwater Lobsters Limited, owners of the holding facility, have been very pleased with the ability of the heat pump system to provide the consistent cold seawater temperatures for holding the lobsters and warm water temperatures generated for laboratory and process uses. The company has decided to build a second holding facility in Cape Breton using a similar heat pump system.

RÉSUMÉ POUR LA DIRECTION

L'objectif de la présente étude est de faire rapport sur la mise au point et la mise en oeuvre d'un programme de surveillance des thermopompes en insistant sur l'application et l'adaptation de l'équipement commercial ordinaire dans le domaine des thermopompes pour l'extraction et l'utilisation de l'énergie thermique de l'eau de mer le long de la côte atlantique du Canada. L'application spécifique étaiet un vivier pour homards propriété de la Clearwater Lobsters Limited de Halifax (Nouvelle-Écosse).

L'examen des données a indiqué : que le système de thermopompe permet d'extraire et d'utiliser l'énergie thermique dans les conditions prévues par la conception initiale, ou dans des conditions s'en rapprochant; qu'il permettait de conserver les homards à des températures uniformément plus faibles ce qui améliorait la qualité du produit et réduisait leur perte de poids; que l'afflux de débris dans l'eau de mer, les organismes marins et le gain de chaleur dans l'enceinte sur la terre ferme étaient les seuls problèmes majeurs et indiquaient d'autres facteurs biologiques nécessitant des esssais et une étude plus poussés.

L'information recueillie dans le cadre de l'étude de surviellance indique que les systèmes avec thermopompes peuvent être adaptés de manière à extraire et à utiliser l'énergie thermique de l'eau de mer. On devrait noter que le système avec thermopompe sera encore plus rentable s'il existe également une utilisation pour l'eau de mer froide (dont l'énergie thermique a été extraite, comme c'est le cas pour l'installation d'élevage du homard.

Le coût total du système, incluant le bâtiment et les composantes mécaniques et électriques reliées spécifiquement à la thermopompe, s'établissait à 481 840,00 $. D'après des économies annuelles estimées à 163 900 $ le simple paiement du système serait récupéré en 2,9 années.

La Clearwater Lobsters Limited, propriétaire de l'installation s'est montrée très satisfaite de l'aptitude du système avec thermopompe à fournir de l'eau de mer uniformément froide pour le vivier à homard et de l'eau chaude destinée aux travaux en laboratoire et à la transformation. La compagnie a décidé de construire au Cap-Breton un deuxième vivier utilisant un système analogue avec thermopompe.

INTRODUCTION

As per instructions from Mr. John Risley, President of Clearwater Lobsters Limited, and in accordance with the commitments to Energy, Mines and Resources Canada - Energy Program, and terms of reference detailed in the letter (from EMR) dated January 31, 1985, A. Orlic & Associates Limited together with Martin Kaneps, Senior Biologist - Clearwater Lobsters Limited, have prepared this status report.

This report contains:

1. Review and assessment of the Ocean Source Heat Pump System in relation to:
   a) Technical and economic assessment of a Heat Pump System application for the extraction of thermal energy from the ocean source seawater.

   b) Suitability and related energy costs by utilizing the by-product of the Heat Pump System (cold seawater) for the holding of live lobsters.

2. Suitability of biological conditions for long term holding of live lobster, in terms of:

   a) improved product quality.

   b) reduced product shrinkage (mortality rate).

3. Economic viability and benefits of the Heat Pump System application for holding of live lobsters.

A. Orlic & Associates Limited.

INTRODUCTION

Conformément aux instructions de M. John Risley, président de la Clearwater Lobster Limited, et respectant les engagements dans le cadre du Programme sur l'énergie, d'Énergie, Mines et Ressources Canada ainsi que le mandat décrit de manière détaillée dans la lettre (d'EMR) en date du 31 janvier 1985, A. Orlic & Associates Limited ainsi que Martin Kaneps, biologiste principal à la Clearwater Lobsters Limited, ont préparé le présent rapport sur l'état des travaux.

Le présent rapport comprend :

1. une revue et une évaluation du système avec thermopompe utilisant l'eau de mer comme source de chaleur en rapport avec :

   a) l'évaluation technique et économique de l'applicabilité d'un système avec thermopompe pour l'extraction d'énergie thermique de l'eau de mer.

   b) le caractère convenable et les coûts associés en énergie de l'utilisation du sous-produit du système avec thermopompe (l'eau de mer froide) pour la conservation des homards vivants.

2. le caractère convenable des conditions biologiques pour la conservation à long terme des homards vivants en termes :

   a) de l'amélioration de la qualité du produit.

b) de la réduction de la perte de poids (taux de mortalité).

3. la rentabilité et les avantages du système avec thermopompe pour la conservation des homards vivants

A. Orlic & Associates Limited.

SYNOPSIS

From August 1982, to March 1983, Interprovincial Engineering Limited of Halifax, Nova Scotia, carried out an investigation of a heat pump design for the extraction and application of thermal energy from the ocean source seawater.

Clearwater Lobsters Limited facility at Clark's Harbour, Shelburne County, Nova Scotia, was identified as a potential location for the testing and evaluation of the ocean source heat pump, due to:

1. The existing system of ocean source seawater supply for holding of live lobster.
2. The existing potential for the research and development in the application of the heat pump by-product, i.e., ocean source cooled seawater, for holding of live lobster through the period of high ambient seawater temperatures that could result in improved product quality and reduced product shrinkage.
3. The potential for utilizing thermal energy produced by the heat pump for the biological research and development of lobster growth culture at elevated ocean source seawater temperatures.

In the fall of 1983, with the moral support from the National Research Council and financial assistance from Energy, Mines and Resources Canada - Technical Assessment and Incentive Programs Energy Conservation and Oil Substitution Branch, Industrial Energy Division, Clearwater Lobsters Limited retained A. Orlic & Associates Limited to design and oversee the implementation of the Heat Pump System at their live lobsters holding facility in Clark's Harbour, Shelburne County, Nova Scotia.

Construction of the facility and installation of equipment and services were completed by the end of May, 1984, and the commissioning of the system was completed by the middle of June 1984.

From June to November 1984; the major effort was expended in assessing the biological conditions of the ocean source precooled seawater for holding of live lobsters and its effects on product quality and mortality rates.

As part of the initial commitment to the National Research Council and Energy, Mines and Resources Canada, Clearwater Lobsters Limited retained A. Orlic & Associates Limited to develop, implement and carry-out a monitoring program of the heat pump performance, with respect to:

1. Practicality of the heat pump application and adaptability of standard commercially available equipment for:

    a) Extraction of thermal energy from ocean source seawater along Canada's Atlantic Coast.

    b) Application of pre-cooled ocean source seawater, a by-product of heat pump installation, for holding of live lobsters and related effects on product quality and mortality rates.

2. Performance of the heat pump installation, in terms of:

    a) Thermal energy extracted from the ocean source seawater in relation to unit electrical energy input into the operation of the heat pump.

    b) Thermal energy output by the heat pump in relation to unit electrical energy input into the operation of the heat pump.

3. Economic evaluation of energy costs with respect to:

a) Unit costs of thermal energy produced by the heat pump in relation to the same level of thermal energy produced by:
   (i) electrical energy through resistance heating method.
   (ii) combustion of No. 2 fuel oil.

b) Unit costs of consumed electrical energy by the facility using cold seawater recirculation systems versus old flow through system for holding of live lobsters.

The operation of the heat pump and the monitoring of its operations were carried out on a continuous basis from April 27, 1985 to November 14, 1985 - when the heat pump and the live lobster holding systems were shut down in preparation for the new lobster season. The system was thus started up and run intermittently until March 31, 1986.

This report presents the performance data and results on the application of the heat pump system and related equipment, with respect to:

1. Extraction of thermal energy from the ocean source seawater.

2. Biological conditions, effects on product quality and mortality rates, in the recirculated cold seawater live lobsters holding system.

3. Biological conditions and the practicality of the elevated seawater temperatures application for lobster growth culture.

Monitored data and operational observations have produced the following results:

A. Application of Heat Pump System and Commercial Equipment

1. For Extraction of Thermal Energy:

With the exception of influx of seaweed and debris through the ocean source seawater supply and marine type of growth on the surfaces of heat exchanging equipment, there were no other major problems with the operation of the heat pump system or its equipment components, in the seawater environment.

The system continuously produced thermal energy at an average temperature of 53.07 °C which was utilized to the maximum required consumption for elevating the temperature of ambient seawater in the Warm Seawater Culture Research Laboratory.

Throughout the monitored period, the heat pump produced thermal energy at an average rate of 416.6 kw.

2. For holding of live lobsters in cold seawater:

Throughout most of the period, the heat pump system produced ocean source make-up seawater to the live lobsters holding system, at the initial design conditions. However, during warm and sunny atmospheric conditions, the holding temperature of the system would rise above design condition due to the excessive thermal energy gain by the cold seawater through the system - mainly in the old dryland pound room.

Although product quality and shrinkage have been significantly improved, from the previously used ambient seawater flow-through method, a number of new biological factors and requirements have been identified and require further investigation at lower than initially designed holding temperatures.

Throughout the period, the average rates of thermal energy extracted from the ocean source make-up seawater for the holding facility are:

- Through Cold Seawater Plate Heat Exchanger -------	372.0 kw
- Through the Heat Pump Evaporator -----------------	284.9 kw
Total rate of thermal energy extracted -------------	656.9 kw

B. Performance of Heat Pump

1. COEFFICIENT OF PERFORMANCE, COMPRESSOR, REFRIGERATING: ratio of the compressor refrigerating effect to the rate of energy input to this shaft of the compressor, in consistent units, in a complete refrigerating plant, under designated operating conditions.

$$\text{E.E.R.} = \frac{\text{energy extracted from seawater}}{\text{energy to operate the heat pump}}$$

$$= \frac{\text{HT3}}{\text{KW2}}$$

$$= \frac{\text{284.9 KW (Average)}}{\text{178.1 KW (Average)}}$$

$$= 1.6$$

2. **COEFFICIENT OF PERFORMANCE, COMPRESSOR, HEAT PUMP:** ratio of the compressor heating effect (heat pump) to the rate of energy input to the shaft of the compressor, is consistent with, in a complete heat pump, under designated operating conditions.

$$\text{C.O.P.} = \frac{\text{energy delivered by the heat pump}}{\text{energy to operate the heat pump}}$$

$$= \frac{\text{HT4}}{\text{KW2}}$$

$$= \frac{416.6 \text{ KW (Average)}}{178.1 \text{ KW (Average)}}$$

$$= 2.34$$

C. Economic Relations

Energy Generated by Heat Pump vs. Energy Generated By Fossil Fuel and Electricity

1. Coefficient of performance for the heat pump through the monitored period was:
   a) Maximum C.O.P. of 3.06
   b) Average C.O.P. of 2.34

2. Calculated cost of thermal energy produced by the heat pump only was determined to be $0.02/kw.

3. Relative cost of thermal energy produced by the heat pump:

a) The heat pump produced 416.6 KW of thermal energy at the condensor with an electrical input of 178.1 KW at the compressors. Comparing this with the thermal energy produced by electric resistance heating we get:

$$\frac{\text{Heat Pump Thermal Energy}}{\text{Electric Resistance Thermal Energy}} = \frac{178.1\text{KW} \times 0.0467\ \$/\text{KWH}}{416.6\text{KW} \times 0.0467\ \$/\text{KWH}}$$

$$= \frac{1}{2.3391}$$

b) Compare the same amount generated by the burning of fossil fuels and we get:

$$\frac{\text{Heat Pump Thermal Energy}}{\text{Fossil Fuel Thermal Energy}} = \frac{178.1\text{KW} \times 0.0467\ \$/\text{KWH}}{416.6\text{KW} \times 0.0470\ \$/\text{KWH}^{*}}$$

$$= \frac{1}{2.354}$$

* See Table B-11

4. The average cost of electrical energy consumed by the facility has been reduced:

- from $ 0.0639/KWH; to $ 0.0467/KWH;
- from $ 0.0921/lb. to $ 0.0677/lb. of product handled,

through the application of the recirculated cold seawater for holding of live lobsters.

5. Calculated economic benefits for the monitored period are:

a) Savings in energy produced by the heat pump relative to conventional thermal and electrical energy:	$81,950

b) Economic benefits through improved product quality:	(+)
c) Economic benefits through reduced product shrinkage:	(+)
Total economic benefit for the 6 month period:	$81,950 (+)

The total annual economic benefits would be $163,900, plus the improved product quality and reduced product shrinkage.

The pay back period, based on the energy savings will be 2.9 years.

Although significant improvements in product quality and shrinkage have been observed, these could not be accurately quantified at the present time due to ongoing biological research and experimentation towards identifying the optimum required operating conditions for the maximum economic benefits and marketing flexibility.

The biological results have shown that further gains in product quality, product shrinkage and marketing flexibility can be achieved with further reduction in the operating cold seawater temperature (holding temperature) of the system.

RÉSUMÉ

Du mois d'août 1982 au mois de mars 1983, l'Interprovincial Engineering Limited de Halifax (Nouvelle-Écosse) a effectué l'étude d'un modèle de thermopompe pour l'extraction d'énergie thermique de l'eau de mer et des applications de la chaleur extraite.

L'installation de la Clearwater Lobster Limited à Clark's harbour, comté de Shleburne (Nouvelle-Écosse), a été identifiée comme un emplacement possible pour les essais et l'évaluation de la thermopompe utilisant l'eau de mer en raison :

1. du système existant d'approvisionnement en eau de mer pour la conservation des homards vivants.
2. des possibilités existantes en matière de recherche et de développement quant aux applications du sous-produit de la thermopompe, c.-à-d. l'eau de mer refroidie, pour la conservation des homards vivants pendant la période de températures ambiantes élevées de l'eau de mer, ce qui pourrait entraîner une amélioration de la qualité du produit et une réduction de la perte de poids.
3. des possibilités d'utilisation de l'énergie thermique produite, par la thermopompe pour la recherche et le développement en biologie appliquée à la culture du homard à des températures de l'eau de mer élevées.

À l'automne de 1983, avec l'appui moral du Conseil national de recherches et l'aide financière d'Énergie, Mines et Ressources Canada - Programmes d'aide technique et d'encouragement, Division de l'énergie industrielle, Direction des économies d'énergie et du remplacement du pétrole - , la Clearwater Lobster Limited retenait les services de Orlic & Associates Limited pour la conception et la surveillance de la mise en oeuvre d'un système avec thermopompe à son installation de conservation de homards vivants à Clark's Harbour, comté de Shelburne (Nouvelle-Écosse).

La construction de l'installation et la mise en place de l'équipement et des services étaient complétées vers la fin de mai 1984 et la mise en service du système a été complétée vers la mi-juin 1984.

De juin à novembre 1984 la plus grande partie des efforts a été consacrée à l'évaluation des conditions biologiques dans l'eau de mer pré-refroidie pour la conservation des homards vivants et de ses effets sur la qualité du produit et les taux de mortalité.

Dans le cadre de son engagement initial envers le Conseil national de recherches et Énergie, Mines et Ressources Canada, la Clearwater Lobster Limited a retenu les services de A. Orlic & Associates Limited pour la mise au point, la mise en oeuvre et l'exécution d'un programme de surviellance du rendement de la thermopompe en fonction des critères suivants :

1. valeur concrète de l'utilisation de la thermopompe et adaptabilité de l'équipement ordinaire disponible dans le commerce pour :

   a) l'extraction de l'énergie thermique de l'eau de mer le long de la côte atlantique du Canada.

b) l'utilisation de l'eau de mer pré-refroidie, un sous-produit de la thermopompe, pour la conservation des homards vivants et les effets associés sur la qualité du produit et les taux de mortalité.

2. rendement de la thermopompe en termes de :

   a) l'énergie thermique extraite de l'eau de mer en rapport avec l'apport unitaire en énergie électrique pour l'exploitation de la thermopompe.

   b) énergie thermique produite par la thermopompe en rapport avec l'apport unitaire en énergie électrique nécessaire pour son exploitation.

3. l'évaluation des coûts en énergie d'après :

   a) le coût unitaire de l'énergie thermique produite au moyen de la thermopompe comparé au coût de production de la même quantité d'énergie thermique par :

      (i) chauffage à l'électricité.
      (ii) chauffage au mazout n° 2.

   b) le coût unitaire de l'énergie électrique consommée par l'installation utilisant des systèmes de recirculation d'eau de mer froide comparé à celui de l'ancien système à écoulement continu par la conservation des homards vivants.

La thermopompe a été exploitée et son fonctionnement a été surveillé de manière ininterrompue du 27 avril 1985 au 14 novembre 1985 alors que la thermopompe et les systèmes de conservation des homards vivants ont été fermés en préparation de la nouvelle saison du homard. Ainsi le système a été mis en marche et a fonctionné de manière intermittente jusqu'au 31 mars 1986.

Le présent rapport fourni les données sur le rendement et les résultats de l'utilisation du système avec thermopompe et équipement associé des points de vue :

1. de l'extraction d'énergie thermique de l'eau de mer.
2. des conditions biologiques, des effets sur la qualité du produit et des taux de mortalité dans le système d'eau de mer froide recirculée pour la conservation des homards vivants.
3. des conditions biologiques et de la valeur concrète de l'utilisation d'eau de mer à température élevée pour la culture du homard.

La surveillance et les observations du fonctionnement ont permis de tirer les conclusions décrites ci-après.

A. Applicatibilité du système avec thermopompe et de l'équipement disponible dans le commerce

1. Pour l'extraction d'énergie thermique, à l'exception de l'entrée d'herbes marines et de débris par les conduites d'amenée d'eau de mer

et de la croissance d'organismes marins sur les surfaces d'échange de chaleur de l'équipement, l'exploitation avec de l'eau de mer du système avec thermopompe ou des autres composantes de l'équipement ne posait aucun problème majeur.

Le système produisait de manière continue de l'énergie thermique à une température moyenne de 53,07 °C qui était utilisée au taux maximum de consommation nécessaire pour l'élévation de la température ambiante de l'eau de mer dans le Laboratoire de recherche sur la culture en eau de mer chaude.

Pendant la durée de la période de surviellance la thermopompe a produit de l'énergie thermique à un taux moyen de 416,6 kW.

2. Pour la conservation des homards vivants dans l'eau de mer froide :

pendant la plus grande partie de la période le système avec thermopompe a fourni de l'eau de mer d'appoint au système de conservation des homards vivants selon les conditions initiales de conception. Toutefois, pendant les périodes de temps ensoleillé et chaud la température de l'eau du système de conservation dépassait la température prévue en raison d'un gain excessif en énergie thermique de l'eau de mer froide circulant dans le système, principalement dans la pièce de l'ancienne enceinte sur la terre ferme.

Quoique la qualité du produit et les pertes de poids aient été sensiblement améliorées par rapport à l'ancienne méthode basée sur l'écoulement en continu d'eau de mer à la température ambiante, on a identifié un certain nombte de facteurs biologiques nouveaux et d'exigences qui doivent faire l'objet d'une étude plus poussée à des températures de conservation plus basses que celles intialement prévues.

Pendant toute la période, les taux moyens d'énergie thermique extraite de l'eau de mer d'appoint pour l'installation de conservation ont été les suivants :

- dans l'échangeur de chaleur à plaques pour l'eau de mer froide ---------372,0 kW

- dans l'évaporateur de la thermopompe --------------284,9 kW

Taux total d'énergie thermique extraite --------------656,9 kW

B. Rendement de la thermopompe

1. COEFFICIENT DE PERFORMANCE, COMPRESSEUR, RÉFRIGÉRATION : Rapport de l'effet réfrigérant du compresseur sur l'énergie fournie à l'arbre de ce compresseur en unités comparables dans une installation de réfrigération complète dans des conditions nominales d'exploitation.

$$\text{E.E.R.} = \frac{\text{énergie extraite de l'eau de mer}}{\text{énergie nécessaire pour l'exploitation de la thermopompe}}$$

$$= \frac{\text{HT3}}{\text{kW2}}$$

$$= \frac{284{,}9 \text{ kW (moyenne)}}{178{,}1 \text{ kW (moyenne)}}$$

$$= 1{,}6$$

2. COEFFICIENT DE PERFORMANCE, COMPRESSEUR, THERMOPOMPE : rapport de l'effet chauffant du compresseur (thermopompe) sur l'énergie fournie à l'arbre de ce compresseur en unités comparables dans une thermopompe complète et dans des conditions nominales d'exploitation.

$$\text{C.O.P.} = \frac{\text{énergie fournie par la thermopompe}}{\text{énergie nécessaire pour l'exploitation de la thermopompe}}$$

$$= \frac{HT4}{kW2}$$

$$= \frac{416{,}6 \text{ kW (Moyenne)}}{178{,}1 \text{ kW (Moyenne)}}$$

$$= 2{,}34$$

C. Relations économiques

Énergie produite par la thermopompe comparée à l'énergie produite au moyen de combustibles fossiles et d'électricité

1. Le coefficient de rendement de la thermopompe pendant la période de surveillance a été :

   a) C.O.P. maximum 3,06

   b) C.O.P. moyen 2,34

2. On a déterminé que le coût calculé de l'énergie thermique produite au moyen de la thermopompe seulement s'élevait à 0,02$/kW.

3. Le coût relatif de l'énergie thermique produite au moyen de la thermopompe a été déterminé comme suit :

a) La thermopompe a produit 416,6 kW d'énergie thermique au condenseur pour un apport en énergie électrique de 178,1 kW aux compresseurs. Si on compare avec l'énergie thermique produite par chauffage électrique on obtient :

$$\frac{\text{Énergie thermique produite par pompe à chaleur}}{\text{Énergie thermique produite à partir de combustibles fossiles}} = \frac{178{,}1 \text{ kW} \times 0{,}0467 \text{ \$/kWh}}{416{,}6 \text{ kW} \times 0{,}0470 \text{ \$/kWh*}}$$

$$= \frac{1}{2{,}354}$$

* Voir tableau B-11

4. Le coût moyen de l'énergie électrique consommée par l'installation a été réduit :

- de 0,0639 $/kWh à 0,0467 $/kWh;
- 0,0921$/lb à 0,0677$/lb de produit manutentionné;

par l'utilisation d'eau de mer froide recirculée pour la conservation des homards vivants.

5. Les avantages économiques calculés pour la période de surveillance sont les suivants :

a) économies réalisées en produisant l'énergie au moyen de la thermopompe par rapport à l'utilisation des sources classiques d'énergie thermique et électrique 81 950 $

b) Avantages économiques résultant de l'amélioration de la qualité du produit (+)

c) Avantages économiques résultant de la réduction de la perte de poids : (+)

Avantage économique total pour la période de 6 mois : 81 950 $ (+)

Les avantages économiques annuels totaux s'élèveraient à 163 900 $ en plus de l'amélioration de la qualité du produit et de la réduction de la perte de poids.

D'après les économies d'énergie la période de récupération sera de 2,9 années.

Quoique l'on a observé des améliorations importantes de la qualité du produit et quant à la perte de poids, ces améliorations ne peuvent être quantifiées avec précision à l'heure actuelle en raison des recherches biologiques et des expériences en cours visant à identifier les conditions d'exploitation optimales pour la maximalisation des avantages économiques et de la souplesse de mise en marché.

Les résultats biologiques ont indiqué que d'autres gains sont possibles, pour ce qui est de la qualité du produit et de la perte de poids, en abaissant davantage la température de l'eau de mer (température de conservation) dans le système.

1.0 OCEAN SOURCE HEAT PUMP SYSTEM

1.1 Background

The North American Lobster, Homarus Americanus, is a high demand, high value, luxury seafood, that has a perceived glamour and assured freshness and quality when marketed alive.

Traditionally, a glut of lobsters occurred during the spring and fall, when the lobster fishing seasons are open on the east coast of Canada and the United States. A shortage of live, quality lobsters exists during the balance of the year. Therefore, the market price for live lobster has fluctuated with supply cycle.

In an attempt to level out this supply cycle and fluctuation in the market price, the lobster industry has tried various systems for the holding of live lobsters beyond the period of peak supply. These efforts have generally resulted in tremendous waste, through mortalities and quality reduction, of the limited lobster resource.

In 1978, the Canadian Fishing Industry (Atlantic Coast) landed 17,800 metric tons of live lobsters, of which 7,800 metric tons were exported live - mainly (43%) to the United States.

In an attempt to reduce the seasonal oversupply of live lobsters to the traditional export market (United States), Clearwater Lobsters Limited carried out an extensive marketing promotion and development for live lobster in Europe and Japan. Although these new markets proved to be receptive to the Canadian live lobster, their past experience cautioned them against high mortality rates, poor quality, and low meat yield especially during the off-season cycle.

First attempts by Clearwater Lobsters Limited to overcome these problems was to develop a land-based lobster impoundment system (unique to the lobster industry) that incorporated high storage density and individualized holding compartments.

This system resulted in an immediate significant improvement in quality during the season - through reduction in damages of live animals due to cannibalism. However, it did not produce significant reduction in mortality, or increase of meat yield quality during warm ambient seawater period.

The Experience has shown that during cold ambient seawater periods, the mortality rate of the held lobsters was lower and the reduction in quality was very nominal. Therefore, these benefits can be extended during warm ambient seawater periods, if:

1. The normal rate of ambient seawater makeup could be significantly reduced to minimize the capital and operating costs of the cooling system.

2. Existing, commercially available, equipment can be adapted for the proposed application.

3. Economic benefits, through reduced mortality and higher product quality, can be achieved to justify high capital investment and increased operating cost.

During the 1970's, as the result of escalating energy costs - particularly the imports of crude oil in the Atlantic Region, the National Research Council of Canada, Energy Division, received a mandate to investigate and assess the alternative long term sources of heat energy that would be cost competitive and would reduce dependency on nonrenewable fossil fuels - and dependency on the imports of crude oil in the Atlantic Region.

The Heat Pump principle for extracting heat energy from low temperature sources and boosting it to a significantly higher level temperature, is a very old technology. However, as the temperature of Heat Source declines, the economic viability of the Heat Pump application tends to decline correspondingly.

The Atlantic Region is surrounded by the Atlantic Ocean. Most of its fishing industry establishments use seawater, on a regular and continuous basis, for the sanitary, cooling and materials handling applications. Although, the annual mean ambient temperature of seawater along Canada's Atlantic Coastline is relatively low, the potential supply of heat energy is vast if it can be economically extracted.

In August, 1982, Interprovincial Engineering Limited of Halifax, Nova Scotia, received authorization from the National Research Council of Canada to proceed with the investigation of a heat pump design for application to:

- extract thermal energy from seawater, and
- correspondingly lower the temperature of seawater for the processing application.

Clearwater Lobsters Limited, the lobsters holding facility at Clark's Harbour, Shelburne County, Nova Scotia, was identified as the potential site for the study.

This facility represented a rare opportunity to investigate and assess the heat pump application with dual benefits:

1. Extracting thermal energy from the ocean seawater along Canada's Atlantic Coast.

2. Application of lower temperature seawater (by-product of thermal energy extraction) for holding of live lobsters during warm periods of ambient seawater.

Interprovincial Engineering Limited completed the investigation and submitted a report, containing the results and recommendations, to the National Research Council of Canada in March of 1983.

Although many biological questions could only be verified by the actual installation and operation of the system - the results indicated the suitability of the heat pump application and the potential long term economic benefits through reduced product losses and improved product quality. For Clearwater Lobsters Limited, these were significant factors to initiate the installation of the system.

With the moral and technical support of the National Research Council of Canada and the financial assistance of Energy, Mines and Resources Canada, in the fall of 1983, Clearwater Lobsters Limited retained A. Orlic & Associates Limited to prepare the design, oversee the construction and commissioning of the heat Pump System.

The construction of facilities and installation of equipment were completed by the end of May, 1984, and the heat pump system was commissioned by the middle of June, 1984.

During the summer of 1984, the biological and energy performance results were adequately encouraging for Clearwater Lobsters Limited to initiate design and construction of new dryland pound holding facility for better biological and energy performances evaluation of the system.

The new holding facility was constructed and commissioned in May, 1985.

Also, during 1984, the National Research Council of Canada, through Clearwater Lobsters Limited, retained A. Orlic & Associates Limited to install the necessary instrumentation and carry out the monitoring of the heat pump performance.

1.2 Facilities and System

The facility is located at Swim Point, Clark's Harbour, Shelburne County, Nova Scotia.

An up-to-date Site Layout Plan is shown on Figure A.1, attached in Appendix 'A'.

The basic facility is made up of:

- Ambient seawater intake system and pumphouse.
- Heat Pump equipment room and underground cold seawater storage and recirculation reservoir.
- Dryland pound lobsters holding room.
- Tank-room for temporary holding, upgrading and shipping of product.
- Ambient temperature outdoor holding reservoir - for temporary receiving and holding of product.
- Dry storage for holding of packaging and shipping materials.
- Processing room - for cooking, shacking and packaging.
- Mechanical, electrical and diesel generator rooms.
- Warm seawater dryland pound laboratory.
- Administration offices, biological laboratory, lunch room and washrooms.

An up-to-date layout of partial facility and equipment is shown on Figure A.2, attached in Appendix 'A'.

A simplified flow diagram of the Ocean Source Heat Pump system is shown in Figure 1.1, and Figure A.3, attached in Appendix 'A'.

1.3 Design Conditions and Projected Performance

The Ocean Source Heat Pump System, installed at Clearwater Lobsters Limited, Clark's Harbour, Shelburne County, Nova Scotia, was designed to:

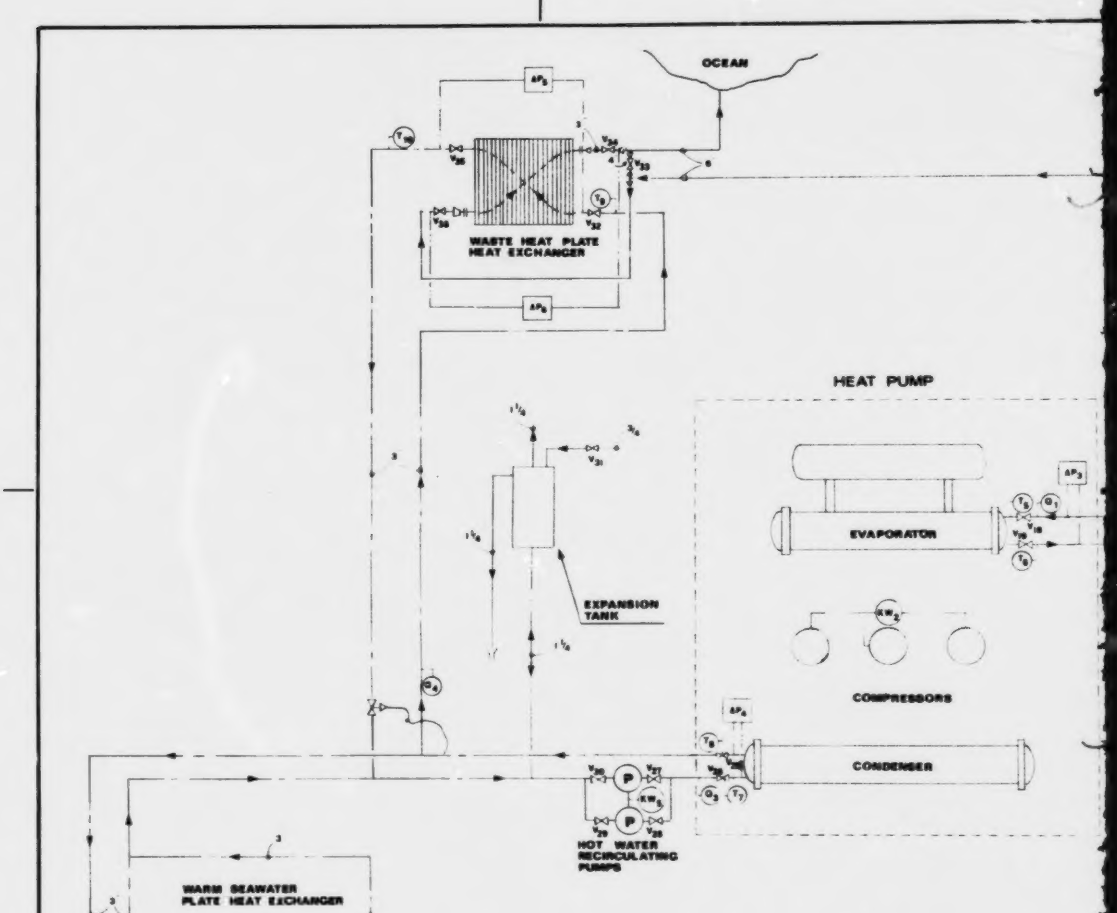
1. To maintain at 4 °C recirculated Seawater for holding of live lobsters in a dryland pound type of facility during the annual period when ambient seawater supply is greater than 4°C.

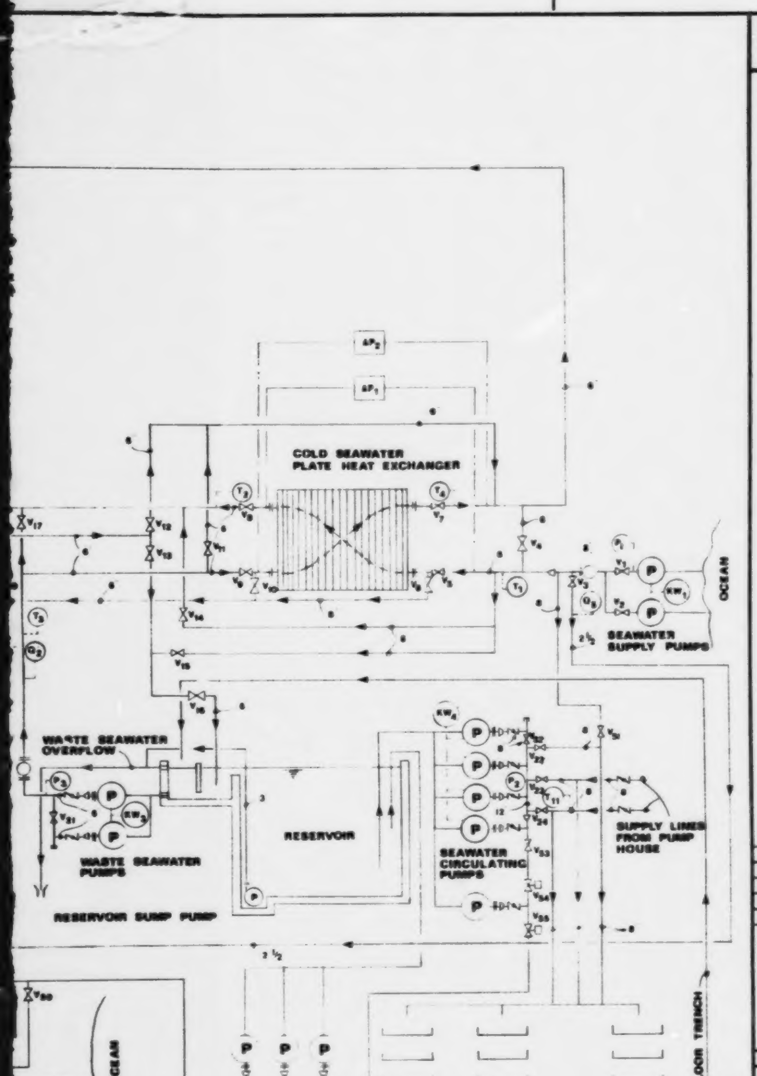
2. To utilize the thermal energy extracted from ambient seawater supply, for:

    a) Raising the temperature of ambient seawater supply to the Warm Seawater Dryland Pound (Laboratory) requirements.

    b) Various domestic and other process heating requirements.

3. To extract thermal energy from abient seawater supply during annual period when ambient seawater temperature is below 4°C for the utilization as stated in 2 (a) and 2 (b).


OCEAN
ΔP_5
ΔP_6
WASTE HEAT PLATE
HEAT EXCHANGER
V_{35}
V_{36}
V_{34}
V_{33}
V_{32}
HEAT PUMP
EVAPORATOR
COMPRESSORS
KW_2
ΔP_3
CONDENSER
ΔP_4
EXPANSION
TANK
V_{31}
G_4
HOT WATER
RECIRCULATING
PUMPS
KW_5
WARM SEAWATER
PLATE HEAT EXCHANGER
V_{37}
V_{38}
V_{39}
V_{40}
WARM SEAWATER
HEAT RECOVERY
PLATE HEAT EXCHANGER
V_{45}
V_{46}
V_{47}
V_{48}
V_{41}
V_{42}
V_{43}
V_{44}
$2\frac{1}{2}$
$1\frac{1}{2}$
3
WARM SEAWATER
DRYLAND POUND
BUILDING HEATING
DOMESTIC HOT WATER



COLD SEAWATER PLATE HEAT EXCHANGER
ΔP_2
ΔP_1
T_1
T_2
T_3
T_4
T_5
T_{11}
Q_1
Q_2
P_1
P_2
P_3
KW_1
KW_3
KW_4
OCEAN
SEAWATER SUPPLY PUMPS
WASTE SEAWATER OVERFLOW
WASTE SEAWATER PUMPS
RESERVOIR
RESERVOIR SUMP PUMP
SEAWATER CIRCULATING PUMPS
SUPPLY LINES FROM PUMP HOUSE
FLOOR TRENCH
SEAWATER RETURN TO RESERVOIR
DRYLAND POUND NO. 1
DRYLAND POUND NO. 2
SEAWATER RETURN PUMP

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION

NOTES:

P_1	PRESSURE – DISCHARGE, SEAWATER SUPPLY PUMP
P_2	PRESSURE – DISCHARGE, SEAWATER CIRCULATING PUMPS
P_3	PRESSURE – DISCHARGE, WASTE SEAWATER PUMP
ΔP_1	PRESSURE DROP – SUPPLY SEAWATER ACROSS C.S.P.H.E.
ΔP_2	PRESSURE DROP – WASTE SEAWATER ACROSS C.S.P.H.E.
ΔP_3	PRESSURE DROP – SUPPLY SEAWATER ACROSS HEAT PUMP EVAPORATOR
ΔP_4	PRESSURE DROP – FRESH WATER ACROSS HEAT PUMP CONDENSER
ΔP_5	PRESSURE DROP – FRESH WATER ACROSS W.H.P.H.E.
ΔP_6	PRESSURE DROP – WASTE SEAWATER ACROSS W.H.P.H.E.
Q_5	WARM SEAWATER DRYLAND POUND SUPPLY – FLOW METER
Q_1	SUPPLY SEAWATER – FLOW METER
Q_2	WASTE SEAWATER – FLOW METER
Q_3	RECIRCULATING FRESH WATER – FLOW METER
Q_4	REJECTED HEAT FROM RECIRCULATING FRESH WATER – FLOW METER
T_1	SUPPLY SEAWATER AMBIENT ENTERING TEMPERATURE – COLD SEAWATER PLATE HEAT EXCHANGER
T_2	SUPPLY SEAWATER LEAVING TEMPERATURE – COLD SEAWATER PLATE HEAT EXCHANGER
T_3	WASTE SEAWATER ENTERING TEMPERATURE – COLD SEAWATER PLATE HEAT EXCHANGER
T_4	WASTE SEAWATER LEAVING TEMPERATURE – COLD SEAWATER PLATE HEAT EXCHANGER
T_5	SUPPLY SEAWATER ENTERING TEMPERATURE – HEAT PUMP EVAPORATOR
T_6	SUPPLY SEAWATER LEAVING TEMPERATURE – HEAT PUMP EVAPORATOR
T_7	FRESH WATER ENTERING TEMPERATURE – HEAT PUMP CONDENSER
T_8	FRESH WATER LEAVING TEMPERATURE – HEAT PUMP CONDENSER
T_9	FRESH WATER ENTERING TEMPERATURE – WASTE HEAT PLATE HEAT EXCHANGER
T_{10}	FRESH WATER LEAVING TEMPERATURE – WASTE HEAT PLATE HEAT EXCHANGER
T_{11}	RECIRCULATED SEAWATER TEMPERATURE – SUPPLY LINE NO 1
KW_1	SUPPLY SEAWATER PUMPS – ELECTRICAL ENERGY METER
KW_2	HEAT PUMP – ELECTRICAL ENERGY METER
KW_3	WASTE SEAWATER PUMPS – ELECTRICAL ENERGY METER
KW_4	SEAWATER CIRCULATING PUMPS – ELECTRICAL ENERGY METER
KW_5	HOT WATER CIRCULATING PUMP – ELECTRICAL ENERGY METER

NO	DATE	REVISION	BY
3	[illegible]	CHANGED INSTRUMENTATION	A O
2	[illegible]	CHANGED INSTRUMENTATION	A O
1	[illegible]	CHANGED INSTRUMENTATION	A O

KEY PLAN

SUB - CONSULTANTS

A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA

CLIENT
CLEARWATER LOBSTER LTD.
CLARKS HARBOUR, N.S.

PROJECT
OCEAN SOURCE HEAT PUMP
PROPOSED MONITORING CONDITIONS

DRAWN BY	SCALE
TRACED BY	DATE
CHECKED BY	APPROVED BY
PROJECT NO. 226	DRAWING NO. MC-01

Figure 1.1

Technically, the above outlined conditions were achievable within the limitations of commercially available and proven equipment and components. However, with seasonal ocean source temperature variations - as shown in Figure 1.2, it would have resulted in:

1. A system that would operate at its peak capacity, and correspondingly, peak efficiency, for only a very short period of the year, i.e., during the period of peak ocean source seawater temperature - as shown in Figure 1.2.

2. A system with very high initial costs for the equipment, facility and services.

3. A system operating at less than its peak capacity for most of the year and correspondingly, at lower operating efficiency, resulting in higher costs of:

    a) Electrical energy usage.
    b) Operating and maintenance personnel.
    c) Equipment, facility and services repair and maintenance.

The optimum size of the heat pump system would have to continuously operate at, or near its peak rated capacity, by

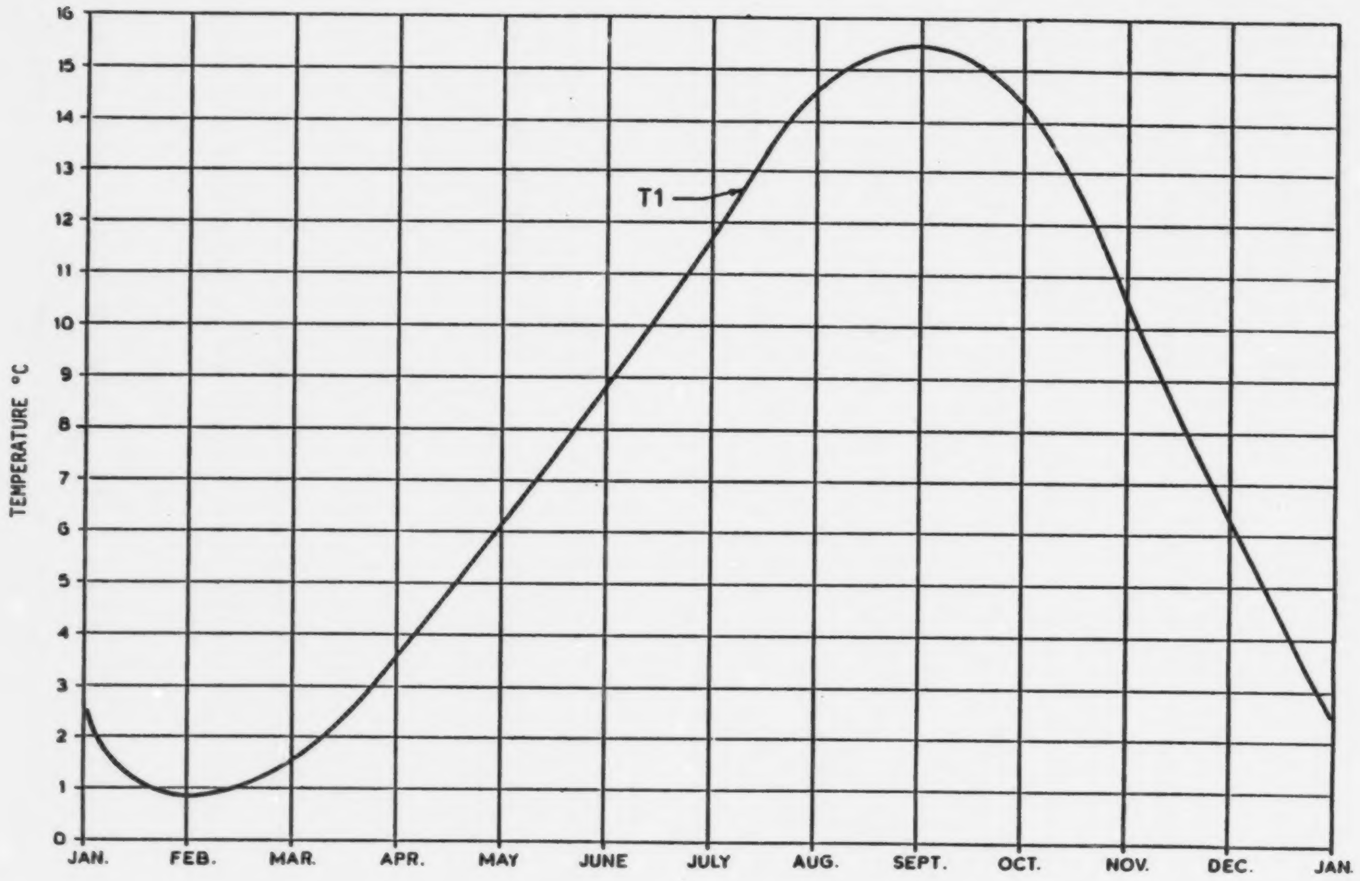


Figure 1.2 - PROJECT AVERAGE YEARLY OCEAN SOURCE SEAWATER TEMPERATURE PROFILE.

maintaining ocean source seawater supply, to the heat pump, temperature constant - as shown in Figure 1.3.

With the requirement of the continuous make-up of ambient seawater to the cold water-lobsters holding system, the overflow (or waste cool seawater) from the system can be utilized to pre-cool ambient seawater supply preceeding the heat pump. Therefore, seasonal temperature variations of the ocean source seawater supply to the heat pump is alleviated, and heat pump capacity optimized, through the use of heat exchanger preceeding the heat pump evaporator, i.e., Cold Seawater Plate Heat Exchanger - as shown in Figure 1.1.

The design parameters used for the sizing of the heat pump were:

1. Temperature to be maintained in dryland pounds + 4°C.

2. Discharge temperature from the heat pump condenser at + 60°C.

3. Approach temperature differential at the Cold Seawater Plate Heat Exchanger at + 1.5°C.

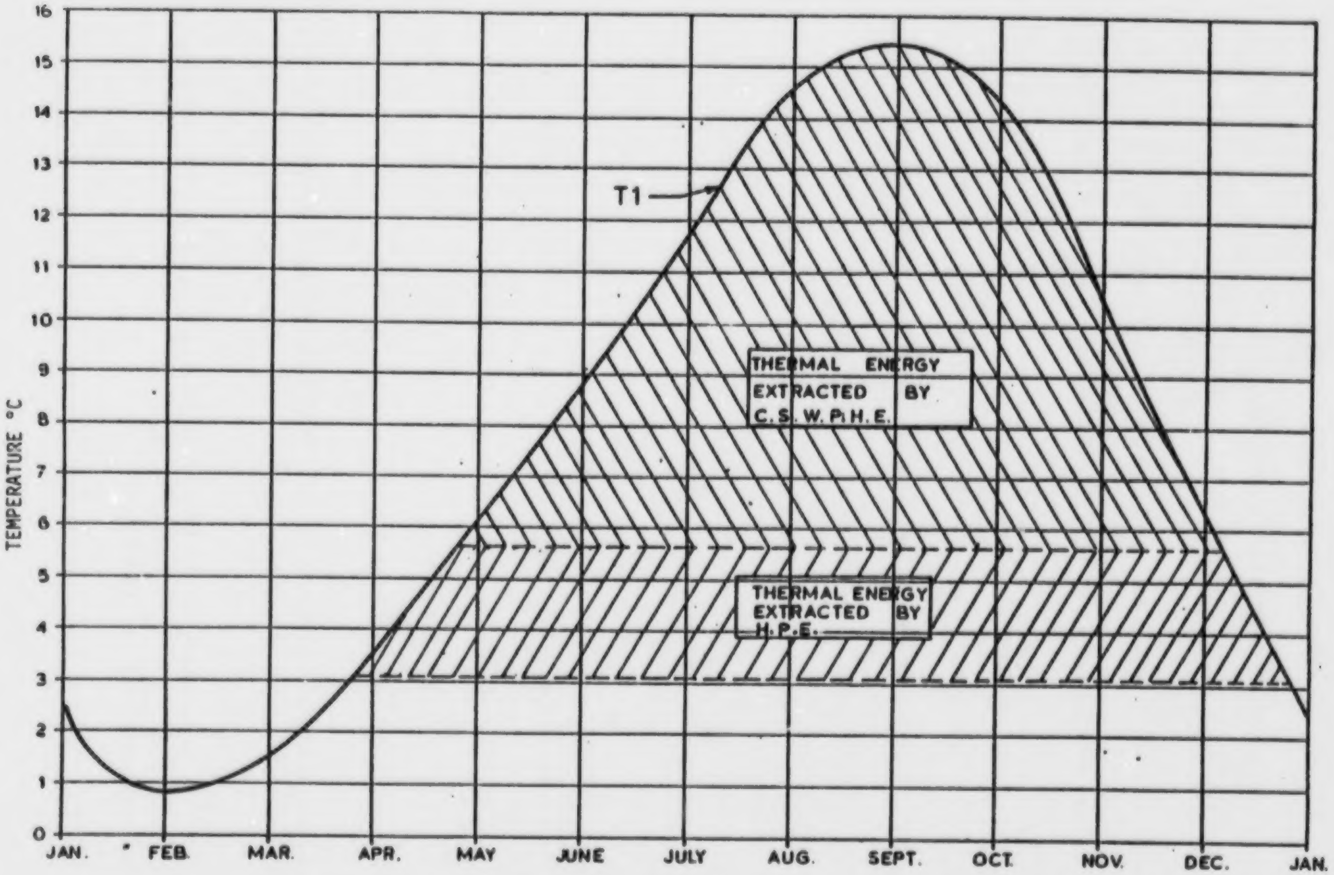


Figure 1.3 - PROJECTED AVERAGE YEARLY OPERATING CONDITIONS FOR HEAT PUMP SYSTEM.

4. Maximum rate of ambient seawater make-up to dryland pound at 37.8 l/s.

5. Maximum cooling load; made up of:

   a) Product of the approach temperature differential and maximum ambient seawater flow rate at the Cold Seawater Plate Heat Exchanger - 223.6 KW.

   b) Thermal energy absorbed by the recirculated cold seawater through dryland pound facility - estimated at 161.9 KW.

   For the maximum total cooling load of 385.5 KW.

Design conditions, temperatures, pressure, flow rates, electrical loads, and thermal energy loads, for the heat pump system shown in Figure 1.1, are detailed in Tables B.1 through B.8, attached in Appendix 'B'.

Various constants employed in calculating energy balance, are shown in Table B.10, attached in Appendix 'B'.

Equipment performance specifications, for the various pieces of equipment shown in Figure 1.1, are attached in Appendix 'C'.

Projected maximum Heat Pump System Performances are:

1. Peak ratio of energy extracted from the ocean source seawater supply:

   - Across Cold Seawater Plate Heat Exchanger: 1,526 KW (HT1).
   - Across Heat Pump Evaporator: 396 KW (HT3).

   Total thermal energy extracted: 1922 KW (HT1 + HT3).

2. Maximum thermal energy supplied by the heat pump: 579 KW (HT4).

3. Maximum heat pump electrical load: 205.2 KW (KW2).

4. Maximum thermal energy extracted from seawater by heat pump per KW electrical energy input: 1.930 KW/KW (HT3/KW2).

5. Maximum thermal energy output per KW of electrical energy input: 2.822 KW/KW (HT4/KW2 = C.O.P.), is equal to the maximum projected Coefficient of Performance for the heat pump.

6. Average cost of thermal energy produced by the heat pump: $0.184/KW.

7. Relative cost of thermal energy produced by the heat pump to:

   a) Electrical resistance heating: (1/2.882), see Table B.7, Appendix 'B'.

   b) Combustion of No. 2 fuel: (1/2.044), see Table B.11, Appendix 'B'.

1.4 Monitoring Program

The objectives of the monitoring program have been:

1. To record and document all measurements of temperatures, flows, pressures and electrical and mechanical power consumption sufficient to calculate a seasonal energy balance.

2. To maintain log of the operation of the plant in order to identify any deficiencies or unavailability, extent of operational supervision and of maintenance required and of the use of replacement equipment of spare parts.

Monitored conditions and the physical locations of various monitored points of the system, are shown in Figure 1.1, and repeated in Figure A.1, Appendix 'A'.

Terms of Reference for the monitoring program are shown in Table D-1, Appendix 'D'.

Description of various monitored conditions is shown in Tables D - 2 through D - 5, Appendix 'D'.

Technical data on monitoring instrumentation and monitored data logging equipment are shown in Appendix 'E'.

Installation details of monitoring instrumentation and monitored data logging equipment are shown in Figures F.1 through F.4, Appendix 'F'.

Details, flow charts, for the control of the data acquisition and storage of system, are shown in Appendix 'G'.

Complementary to the objectives previously stated in this Section, operating conditions of the heat pump system are to achieve and maintain the biological environment for holding of live lobsters, which could result in:

1. Improved product quality.
2. Reduced product shrinkage through mortality.
3. Reduced electrical energy costs per unit weight of product.
4. Provide flexibility for the export markets.

Therefore, the parallel objective to the monitoring program, for assessing the practicality and economic viability of the heat pump for extracting thermal energy from an ocean source seawater, is also to assess the suitability and economic benefits of using its by-product (cold seawater) for holding and maintaining of live lobsters through the annual periods of high ambient temperatures of the ocean source seawater supply.

Although, the monitoring program has been mainly tailored to assess and evaluate the performance of the heat pump, some of the monitored data can be utilized to evaluate and assess the biological, operations and economical results for holding and maintaining of live lobsters.

1.5 Analytical Monitored Results

It was originally anticipated that the monitoring program would be commissioned on, or before, March 31, 1985. Due to long deliveries on some of the monitoring instrumentation, the commissioning of the monitoring program was delayed until April 27, 1985.

Also, due to idle period of the facility, being between lobster seasons and lack of product in storage, the heat pump system was not activated until May 10, 1985.

Additional delays were experienced with facility monitoring instrumentation, such as: temperature sensor (T11), pressure sensor (P1), and electrical load sensor (KW1). Although these sensors had to be replaced and monitoring of these corresponding conditions was delayed to:

- T11: recirculated cold seawater temperature - July 11, 1985.
- KW1: electrical load of the ocean source seawater supply pumps - July 17, 1985.
- P1: supply pressure of the ocean source seawater supply - July 19, 1985.

Weekly tabulated data of the average daily monitored conditions of temperature, pressure, flow rates and electrical power loads from April 27, 1985 to November 21, 1985, are shown in Tables H - 1 through H - 30, Appendix 'H'.

The more pertinent data have been plotted for comparison and evaluation purposes, and are shown in the succeeding sections.

A. Temperatures

1. Ocean Source Ambient Seawater Supply

Variation in the average daily ocean source seawater supply temperature, from April 7, 1985 to January 16, 1986 is shown in Figure 1.4. Although there are significant daily variations in

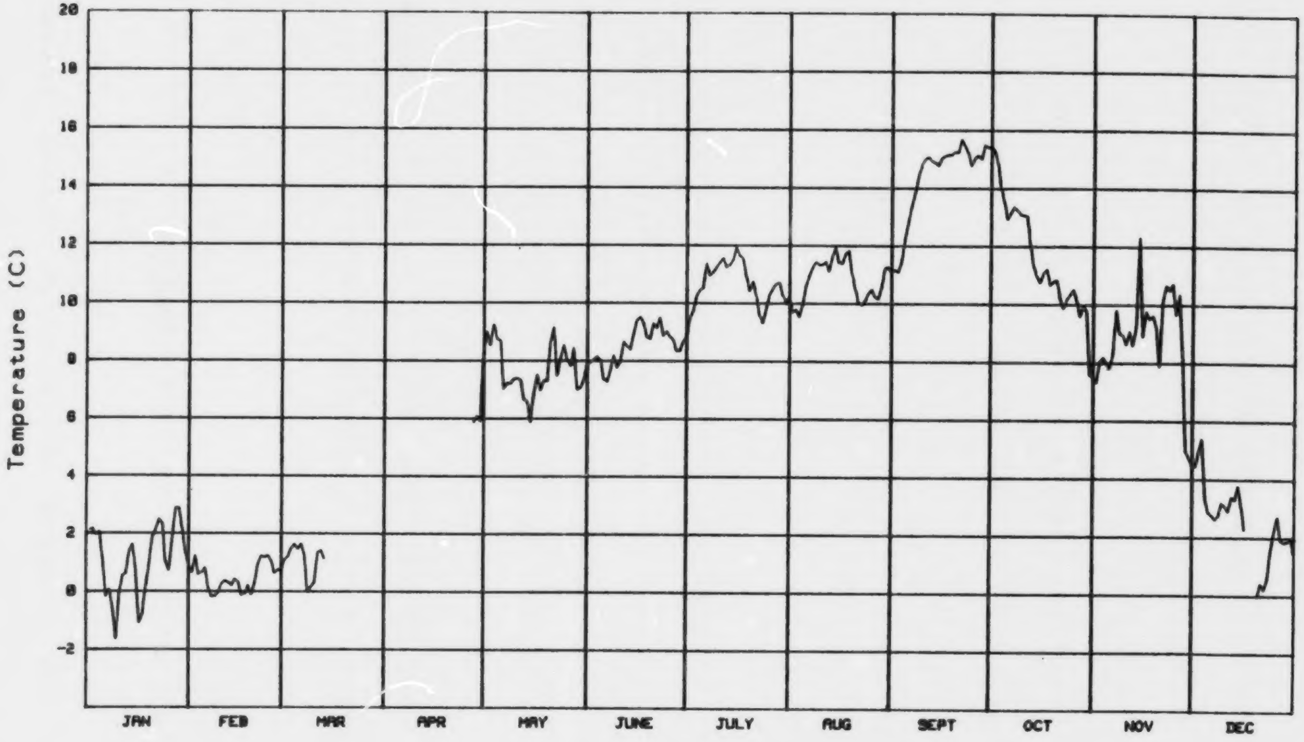


Figure 1.4 - Average Daily Source Seawater Supply Temperatures (T1)

the temperature of the ocean source seawater, the yearly temperature profile closely resembles the projected values shown in Figure 1.2. Daily variations are mainly influenced by the variation in atmospheric conditions, i.e., weather, and temperature. Recorded: maximum temperature of the ocean source seawater supply + 15.683°C was reached on September 20, 1985, and the minimum temperature of 1.3°C on January 16, 1986.

Average daily variation of the ocean source seawater supply temperature (T1) as it passes through the heat pump system, i.e., Cold Seawater Plate Heat Exchanger (C.S.W.P.H.E.) (T5), Heat Pump Evaporator (H.P.E.), and into Cold Seawater Recirculation Reservoir (C.S.W.R.R.), (T6), is shown in Figure 1.5. It shows that throughout the period, the temperature of the ocean source seawater supply is:

- T5: leaving C.S.W.P.H.E. is significantly higher than the design condition of 5.6°C.

- T6: leaving H.P.E. and entering C.S.W.R.R. was hovering around the design condition of 3.1°C.

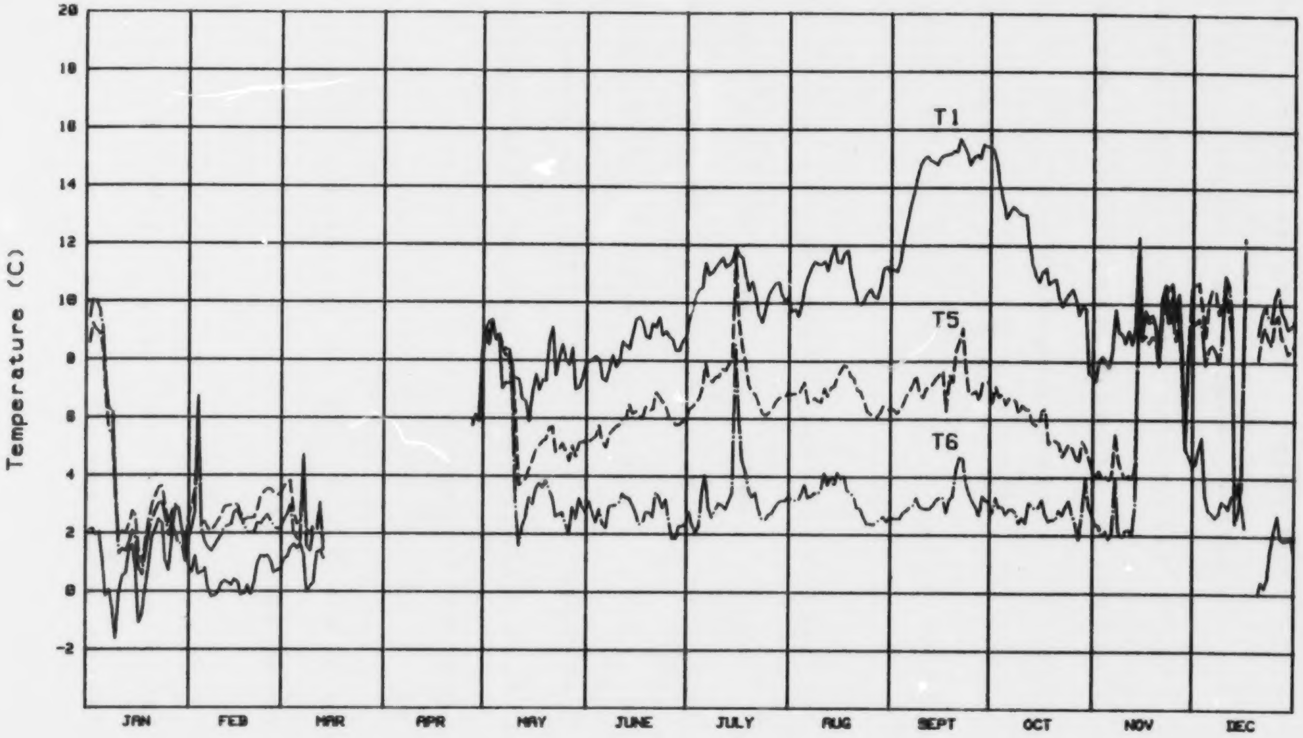


Figure 1.5-Average Daily Temperatures of Ocean Seawater Supply:
-Entering C.S.W.P.H.E. (T1)
-Leaving C.S.W.P.H.E. and Entering H.P.E. (T2 & T5)
-Leaving H.P.E. and Entering C.S.W.R.R. (T6)

2. Cold Seawater Plate Heat Exchanger (C.S.W.P.H.E.)

Average daily temperatures of the ocean source seawater entering (T1) and leaving (T5) C.S.W.P.H.E., and cold water waste seawater entering C.S.W.P.H.E. (T3), are shown in Figure 1.6. It shows that the temperature profile of T5, as shown in Figures 1.5 and 1.6, reflects the temperature profile of the entering cold stream (T3). T3, being profile of the cold seawater returning from the cold seawater dryland pound.

Variation in the average daily approach temperature at C.S.W.P.H.E., i.e., ocean source seawater supply (T5) leaving and cold waste seawater (T3), entering, are shown in Figure 1.7. Throughout the period, except during the months of September and October, the approach temperature (T5 - T3), was less than the design condition of 1.45 °C. The variation in (T5 - T3) represents variation in required approach cooling load.

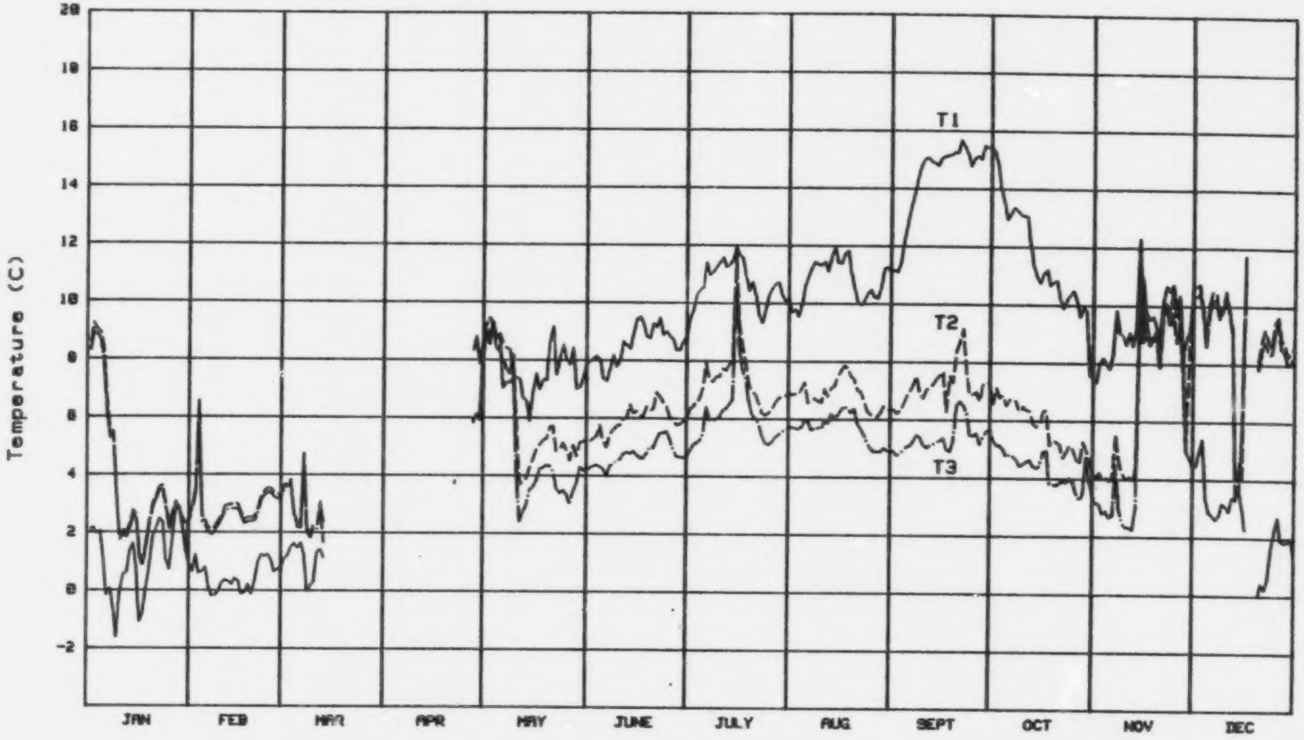


Figure 1.6-Average Daily Temperatures at C.S.W.P.H.E. :
-Entering Ocean Source Seawater Supply (T1)
-Leaving Ocean Source Seawater Supply (T2)
-Entering Cold Waste Seawater (T3)

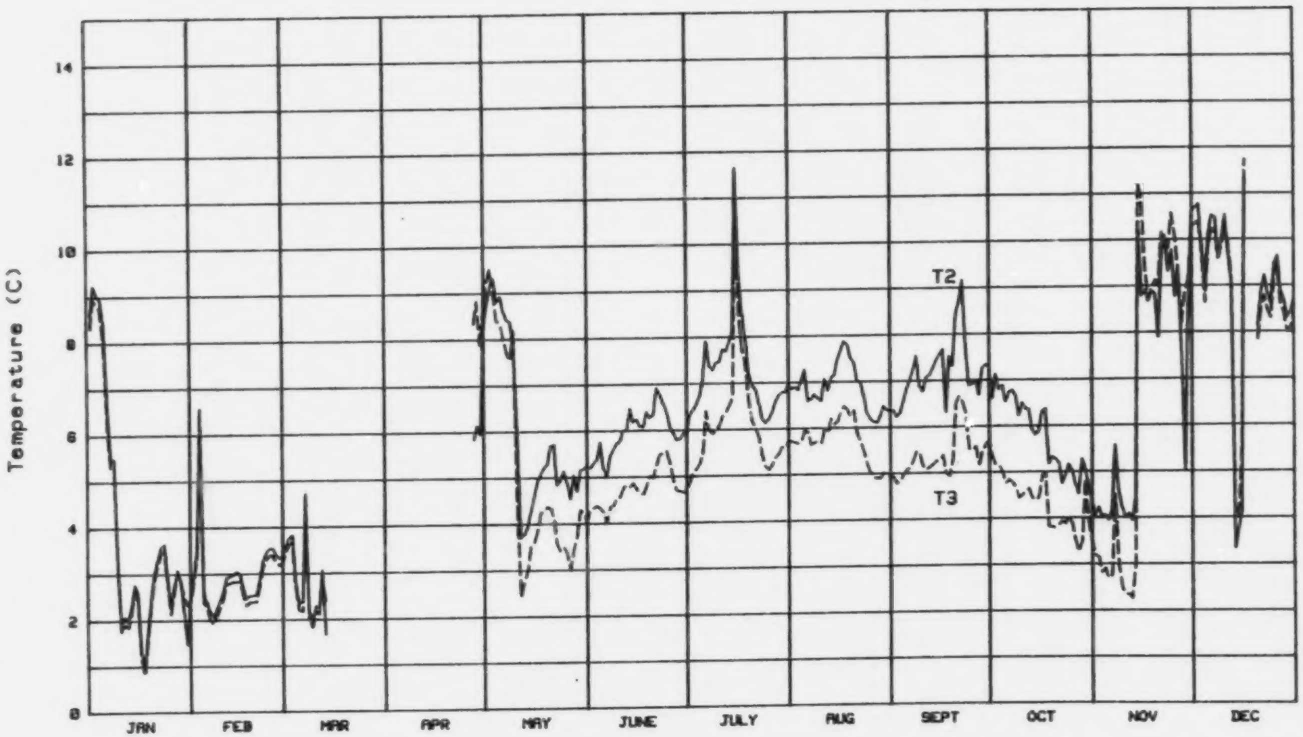


Figure 1.7-Average Daily Approach Temperatures at C.S.W.P.H.E. :
-Leaving Ocean Source Seawater Supply (T2)
-Entering Cold Waste Seawater (T3)

3. Heat Pump Evaporator

Average daily temperature of ocean source seawater supply entering (T5) and leaving (T6) Heat Pump Evaporator (H.P.E.), are shown in Figure 1.8. The temperature variation (T5 - T6) represents the total demand cooling load by the facility, and correspondingly, the total thermal energy extracted from ocean source seawater supply.

4. Recirculated Cold Seawater

Average daily temperatures of the recirculated cold seawater; leaving C.S.W.R.R. to Cold Seawater Dryland Pound (C.S.W.D.L.P.) (T11), and leaving C.S.W.D.L.P. and returning to C.S.W.R.R., are shown in Figure 1.9. The variation in (T3 - T11) represents the variation in thermal energy gain of the Cold Seawater Stream through C.S.W.D.L.P. The average daily temperature variation (T3 - T6) is shown in Figure 1.10.

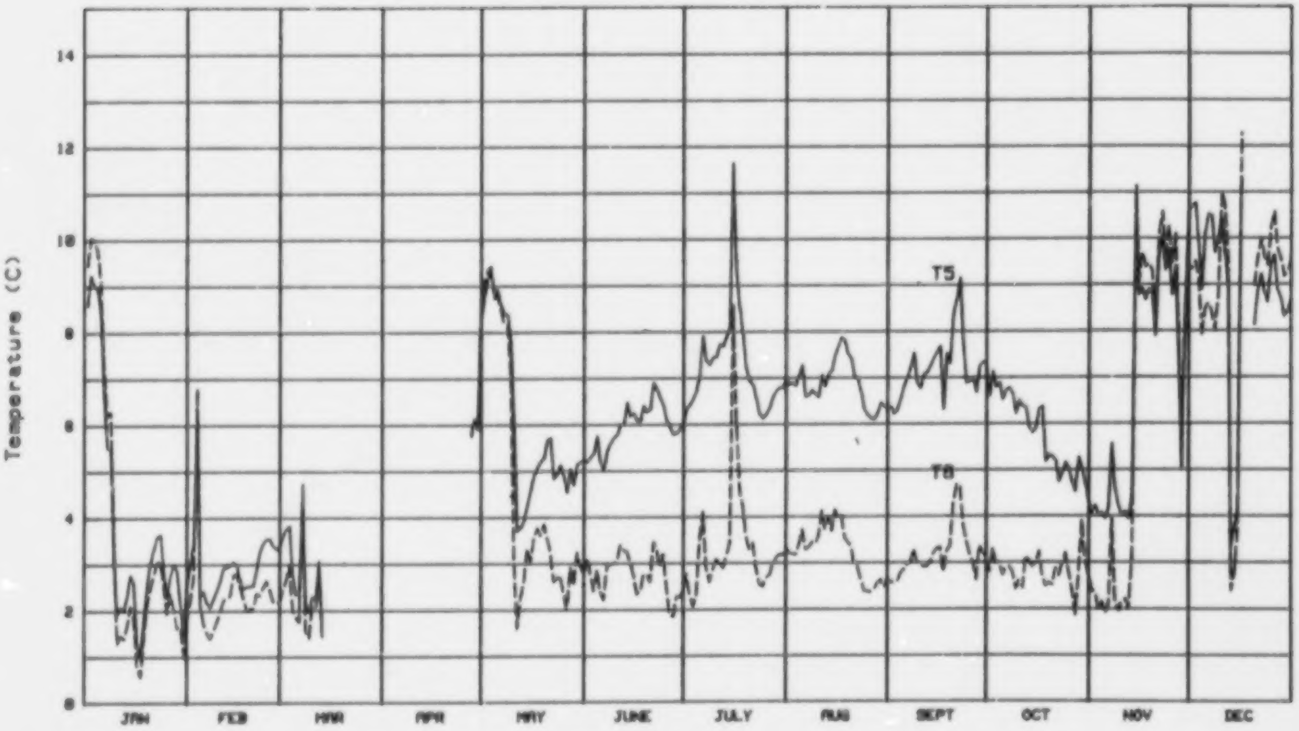


Figure 1.8-Average Daily Temperatures at H.P.E. :
-Entering Ocean Source Seawater Supply (T5)
-Leaving Ocean Source Seawater Supply (T6)

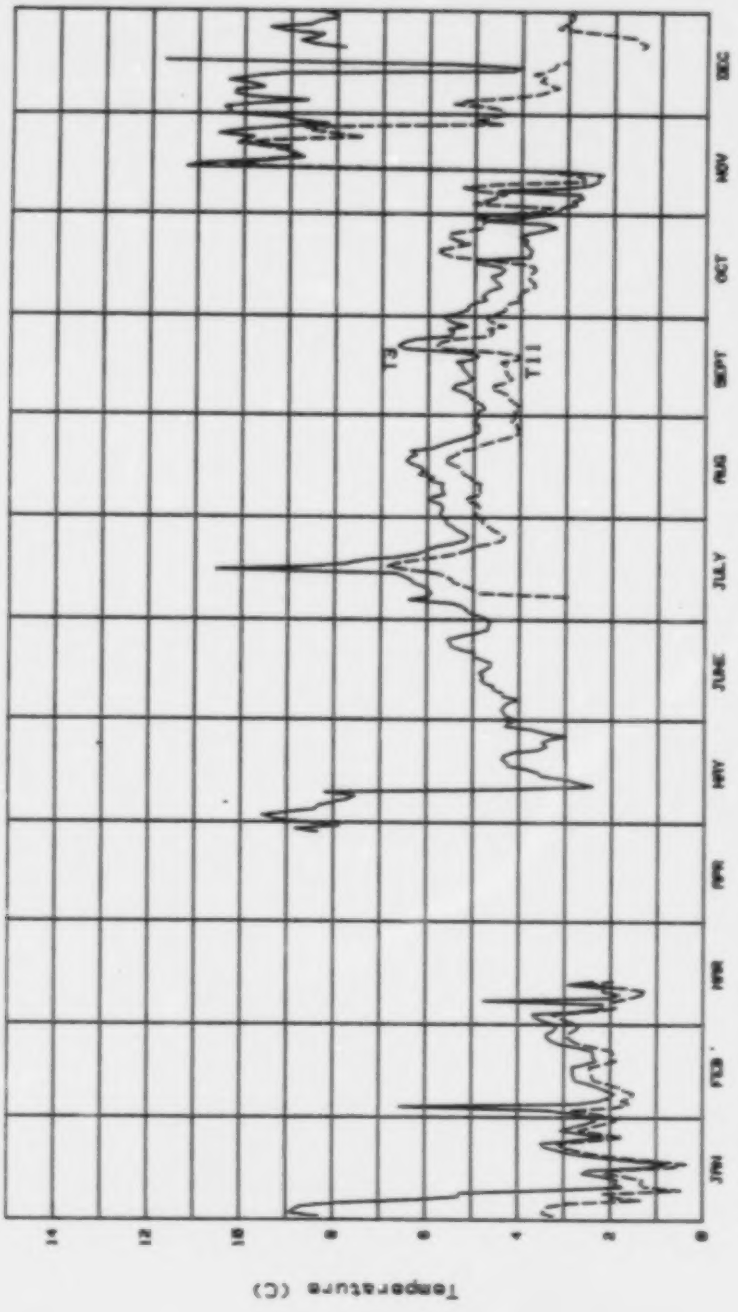


Figure 1.9—Average Daily Temperatures of Recirculated Cold Seawater:
—Entering C.S.W.D.L.P. (T11)
—Leaving C.S.W.D.L.P. (T3)

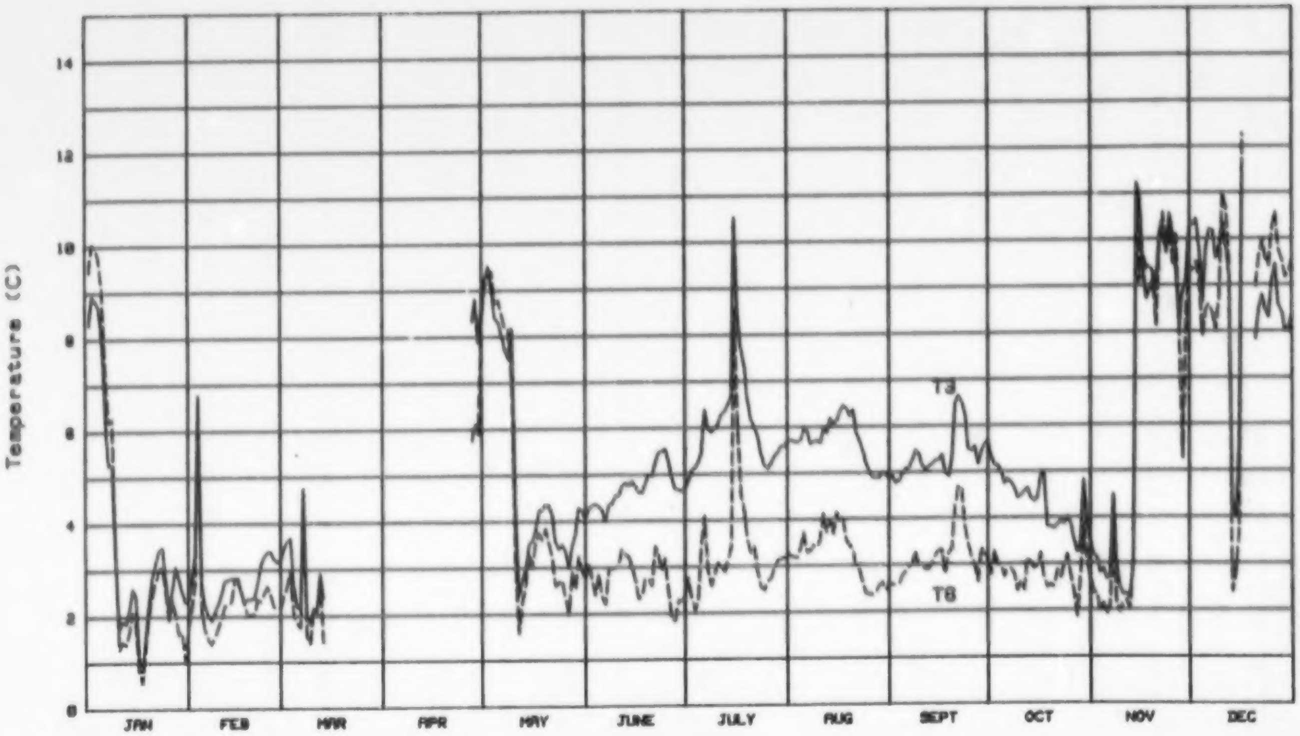


Figure 1.10-Average Daily Temperatures at C.S.W.R.R. :
-Entering Ocean Source Seawater Supply (T6)
-Entering Returning Recirculated Cold Seawater (T3)

5. Recirculated Fresh Water

Recirculated fresh water is a closed loop flow stream used for extracting and transferring thermal energy generated by the heat pump.

Average daily temperature variations of the fresh water stream entering (T7) and leaving (T8) Heat Pump Condenser (H.P.C.), are shown in Figure 1.11.

The excess thermal energy, not utilized for the process and domestic requirements, is rejected through Waste Heat Plate Heat Exchanger (W.H.P.H.E.). The W.H.P.H.E. is also employed for limiting the temperature of fresh stream leaving H.P.C. (T8) to 60°C.

Average daily temperature variation of the recirculated fresh water stream through W.H.P.H.E., is shown in Figure 1.12. The variation in (T8 - T10) represents the rate of thermal energy rejected to waste from the recirculated fresh water stream.

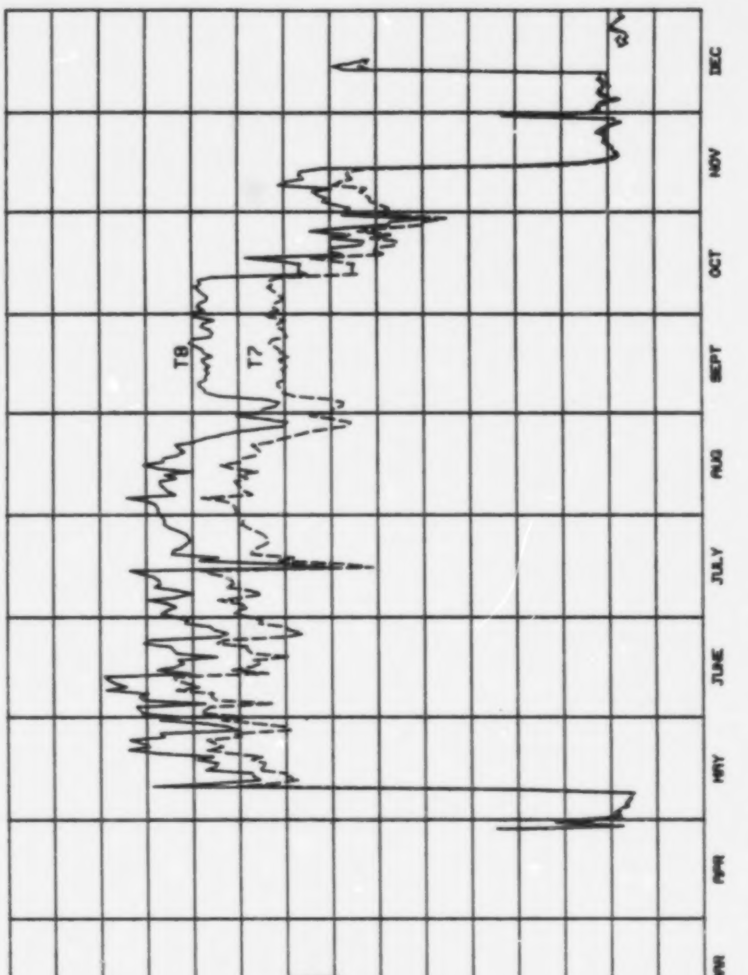


Figure 1.11-Average Daily Temperatures at H.P.C. :
-Entering Recirculated Fresh Water (T7)
-Leaving Recirculated Fresh Water (T8)

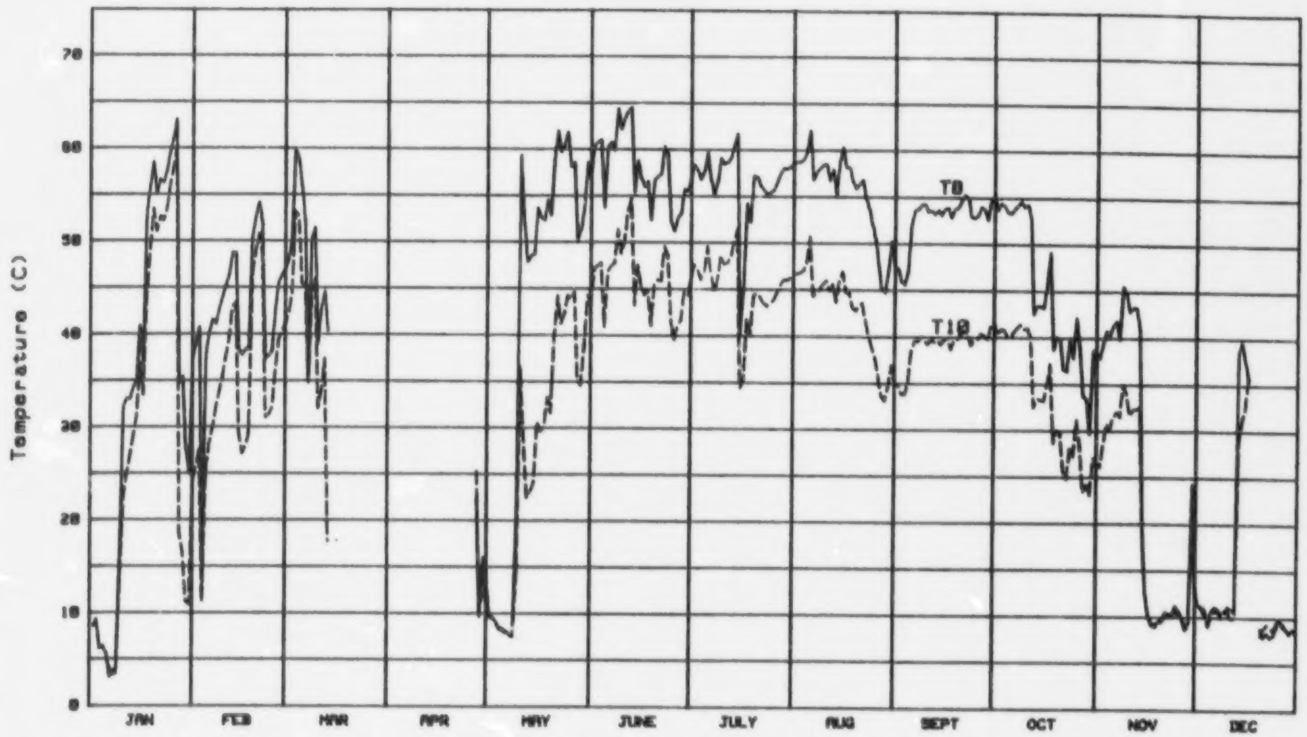


Figure 1.12-Average Daily Temperatures at W.H.P.H.E. :
-Entering Recirculated Fresh Water (T8)
-Leaving Recirculated Fresh Water (T10)

B. Flow Rates

1. Ocean Source Seawater Supply

Average daily flow rates of the ocean source seawater supply, i.e., the make-up rate to the C.S.W.D.L.P. system (Q1), and the overflow (drainage) of cold waste seawater from the C.S.W.D.L.P. system (Q2), are shown in Figure 1.13. It shows that the make-up rate, throughout the period, has been significantly lower than the design rate of 37.8 l/s. Difference (Q1 - Q2) represents the losses of the cold seawater through the system and through the overflow at C.S.W.R.R.

2. Recirculated Fresh Water

The average daily recirculation rate of fresh water through H.P.C. (Q3) and the corresponding rate diverted through W.H.P.H.E. (Q4), are shown in Figure 1.14. The average rate of recirculated fresh water Q3, throughout the period, is somewhat greather than the design rate of 12.7 l/s.

3. Warm Seawater Dryland Pound (W.S.D.L.P.)

Daily average rate of the ocean source seawater supply to W.S.W.D.L.P. (Q5) is shown in Figure 1.15. The average make-up rate, throughout the period, has been lower than the design rate of 6.3 l/s.

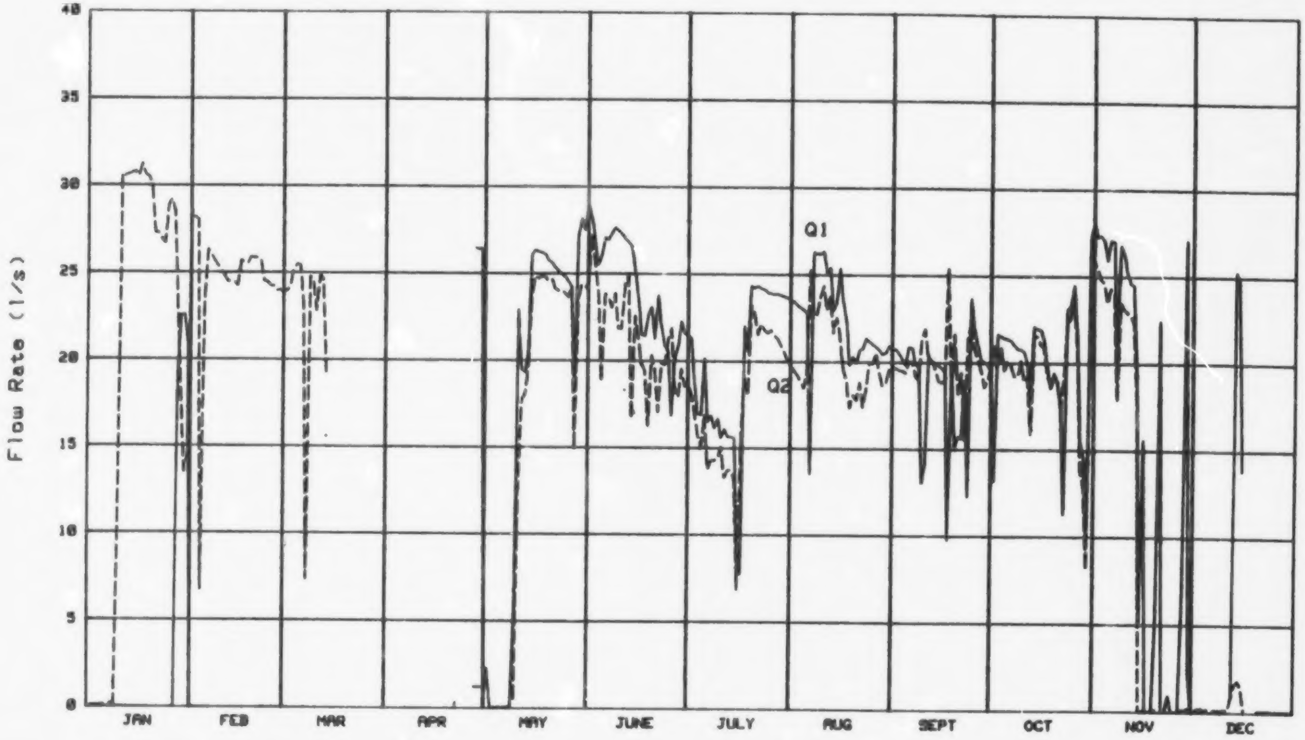


Figure 1.13-Average Daily Flow Rates:
-Ocean Source Seawater Supply (Q1)
-Cold Waste Seawater Discharge (Q2)

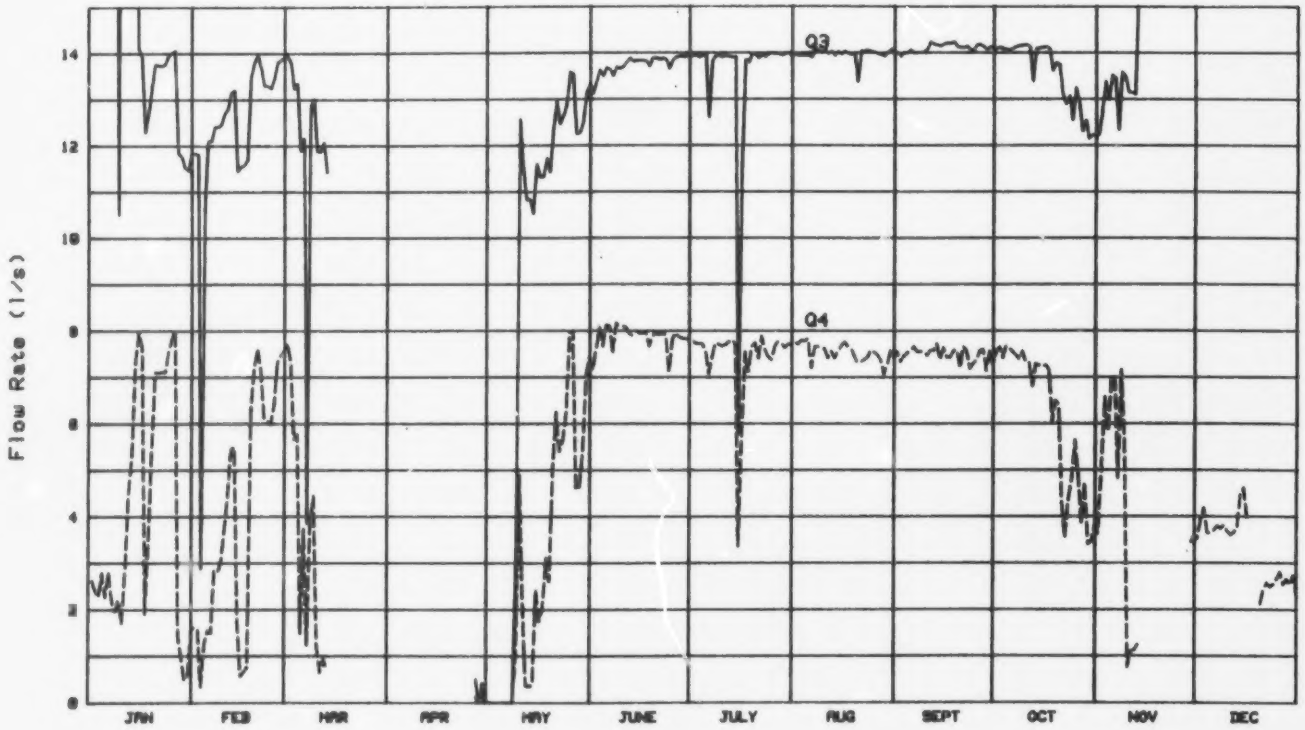


Figure 1.14-Average Daily Flow Rates of Recirculated Fresh Water:
-Through H.P.C. (Q3)
-Through W.H.P.H.E. (Q4)

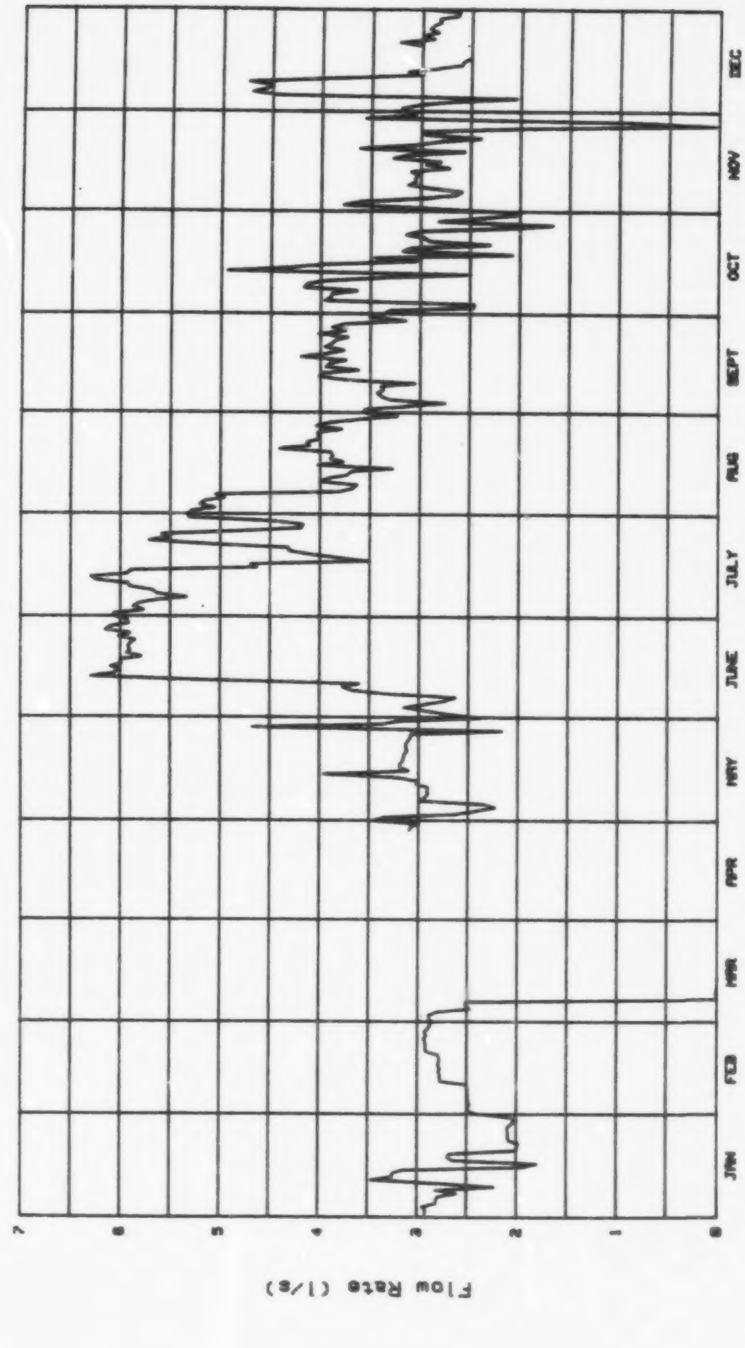


Figure 1.15-Average Daily Flow Rates of Ocean Source Seawater Supply to W.S.W.D.L.P.(Q5)

C. Pressures

Average daily supply pressures of:

- Ocean Source Seawater supply to C.S.W.D.L.P. system (P1);
- Recirculated cold seawater to C.S.W.D.L.P. systsem (P2); and
- Cold waste seawater discharge from C.S.W.D.L.P. System (P3);

are shown in Figure 1.16.

The corresponding design condition for supply pressures were:

- Ocean source seawater supply - 360 kPa;
- Recirculated Cold Seawater - 195 kPa; and
- Cold waste seawater - 270 kPa.

D. Differential Pressures

1. Cold Seawater Plate Heat Exchanger (C.S.W.P.H.E.)

Average daily pressures drop across C.S.W.P.H.E., for:

- Ocean Source Seawater Supply Stream (DP1); and
- Cold Waste Seawater Stream (DP2);

are shown in Figure 1.17.

The corresponding design conditions were:

- Ocean Source Seawater Supply Stream - 90 kPa at flow rate (Q1) of 37.8 l/s;
- Cold Waste Seawater Stream - 90 kPa at flow rate of 34.7 l/s.

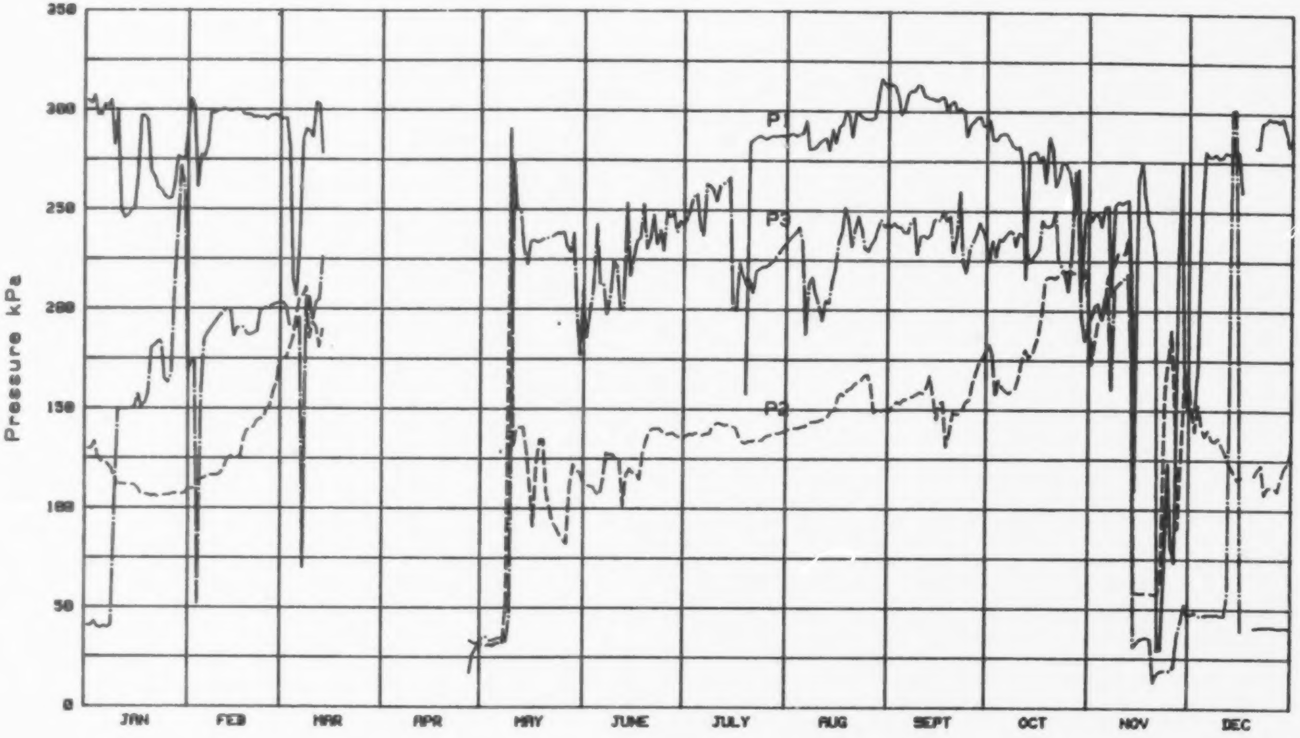


Figure 1.16-Average Daily Operating Pressures:
-Ocean Source Seawater Supply (P1)
-Recirculated Cold Seawater (P2)
-Cold Waste Seawater (P3)

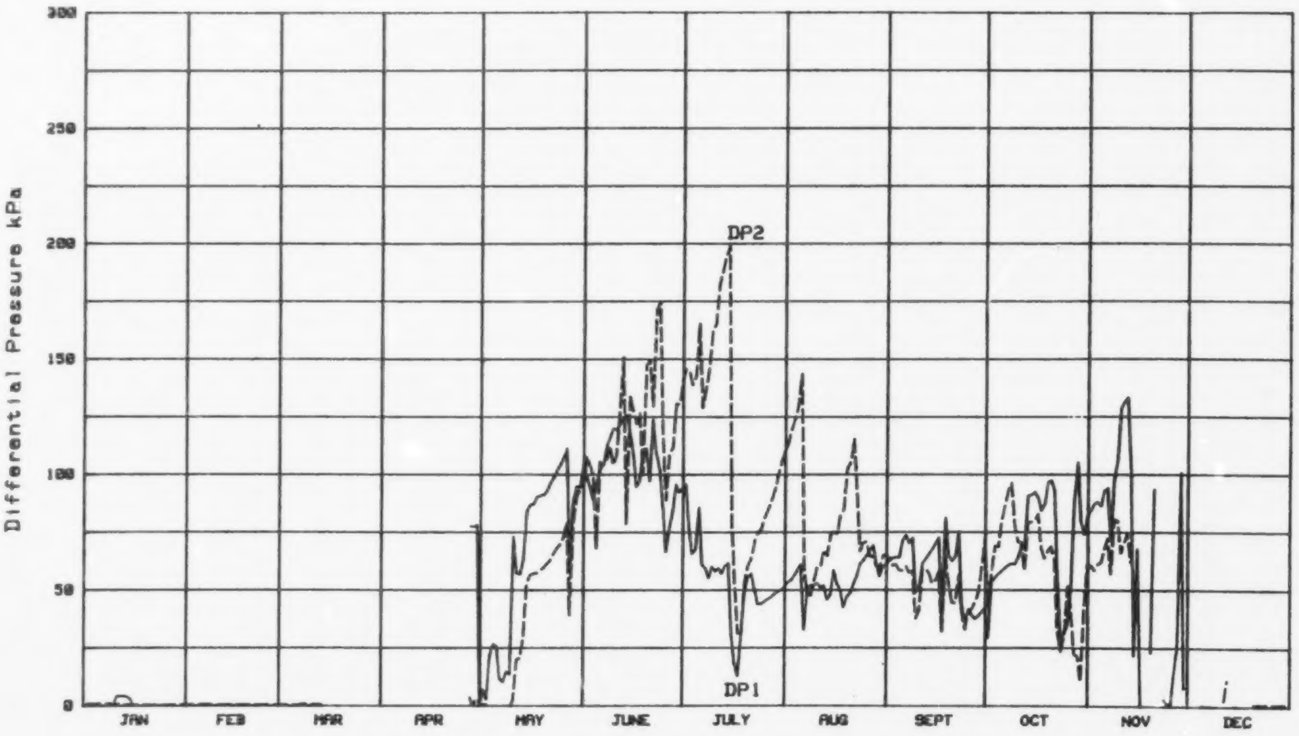


Figure 1.17-Average Daily Pressure Drop Across C.S.W.P.H.E. :
-Ocean Source Seawater Supply Stream (DP1)
-Cold Waste Seawater Stream (DP2)

It shows that for both streams the pressure drop has been significantly greater than the design condition, taking into consideration that the flow rates had been significantly lower than the design condition - as has been shown in Figure 1.13.

2. Heat Pump Evaporator (H.P.E.)

Average daily pressure drop (DP3) of the ocean source seawater supply stream (Q1), through the H.P.E., is shown in Figure 1.18.

The corresponding design condition was 128 kPa for the flow rate of 37.8 l/s.

3. Heat Pump Condenser (H.P.C.)

Average daily pressure drop (DP4), of fresh water stream (Q3) through the H.P.C., is shown in Figure 1.19.

The corresponding design condition was 35 kPa for the flow rate of 12.7 l/s. Taking into consideration that the average flow rate (Q3) was greater than 12.7 l/s, the pressure drop of fresh water stream through the H.P.C. has been near its design condition.

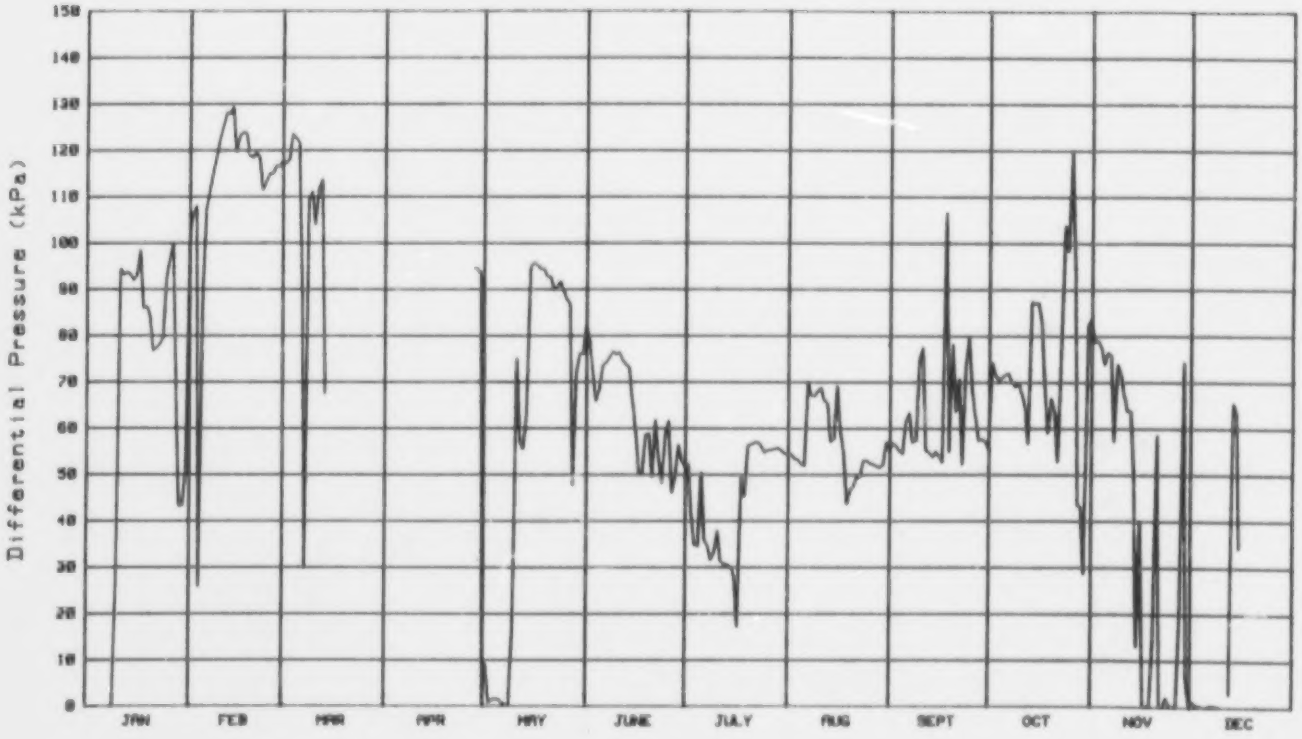


Figure 1.18 - Average Daily Pressure Drop Across H.P.E.
- Ocean Source Seawater Supply Stream (DP3)

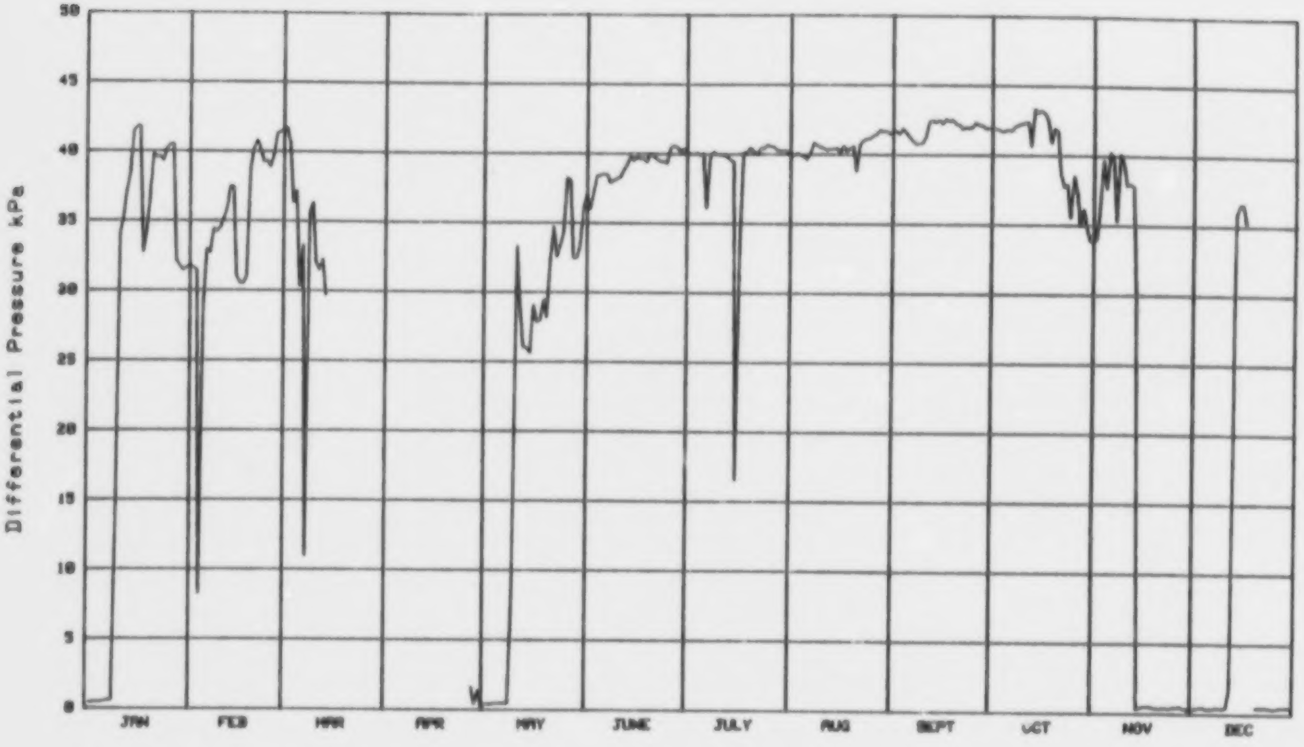


Figure 1.19-Average Daily Pressure Drop Across H.P.C. 1
-Recirculated Fresh Water Stream (DP4)

E. Electrical Loads

Average daily electrical loads for:

- Ocean Source Seawater Supply Pumps (KW1);
- Heat Pump (KW2);
- Cold Waste Seawater Pumps (KW3); and
- Recirculating fresh water pumps (KW5);

are shown in Figure 1.20. The average daily electrical load for the cold seawater recirculating pumps (KW4) are shown in Figure 1.21.

The corresponding maximum design conditions were:

- Ocean Source seawater supply (KW1) - 22.8 KW.
- Heat Pump (KW2) - 205.2 KW.
- Cold Waste Seawater Pumps (KW4) - 13.3 KW.
- Recirculated cold seawater pumps (KW4) - 74.7 KW.
- Recirculated hot fresh water pumps (KW5) - 5.7 KW.

F. Energies

1. Thermal Energy Extracted

Average daily rate variation of the thermal energy extracted from ocean source seawater supply through:

- Cold Seawater Plate Heat Exchanger (HT1); and
- Heat Pump evaporator (HT3);

are shown in Figure 1.22.

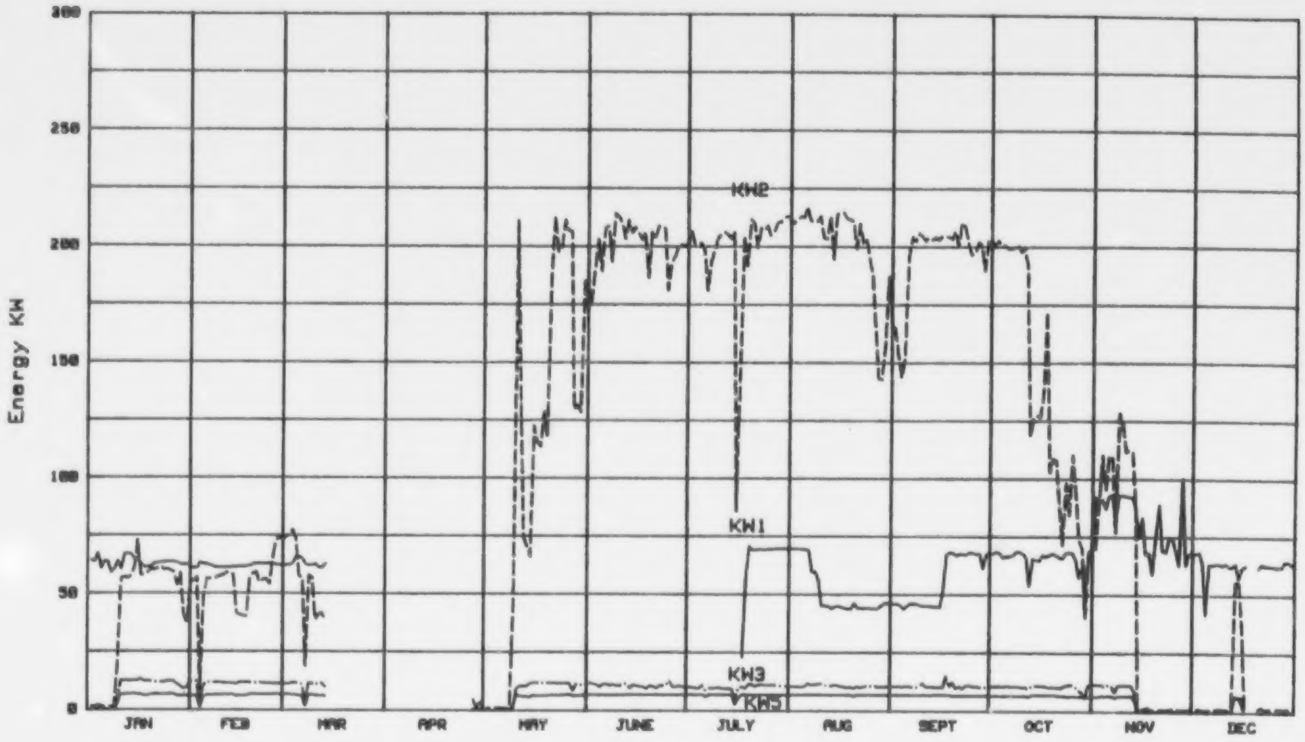


Figure 1.20–Average Daily Electrical Loads:
-Ocean Source Seawater Supply Pumps (KW1)
-Heat Pump Compressors (KW2)
-Cold Waste Seawater Pumps (KW3)
-Recirculating Hot Fresh Water Pumps (KW5)

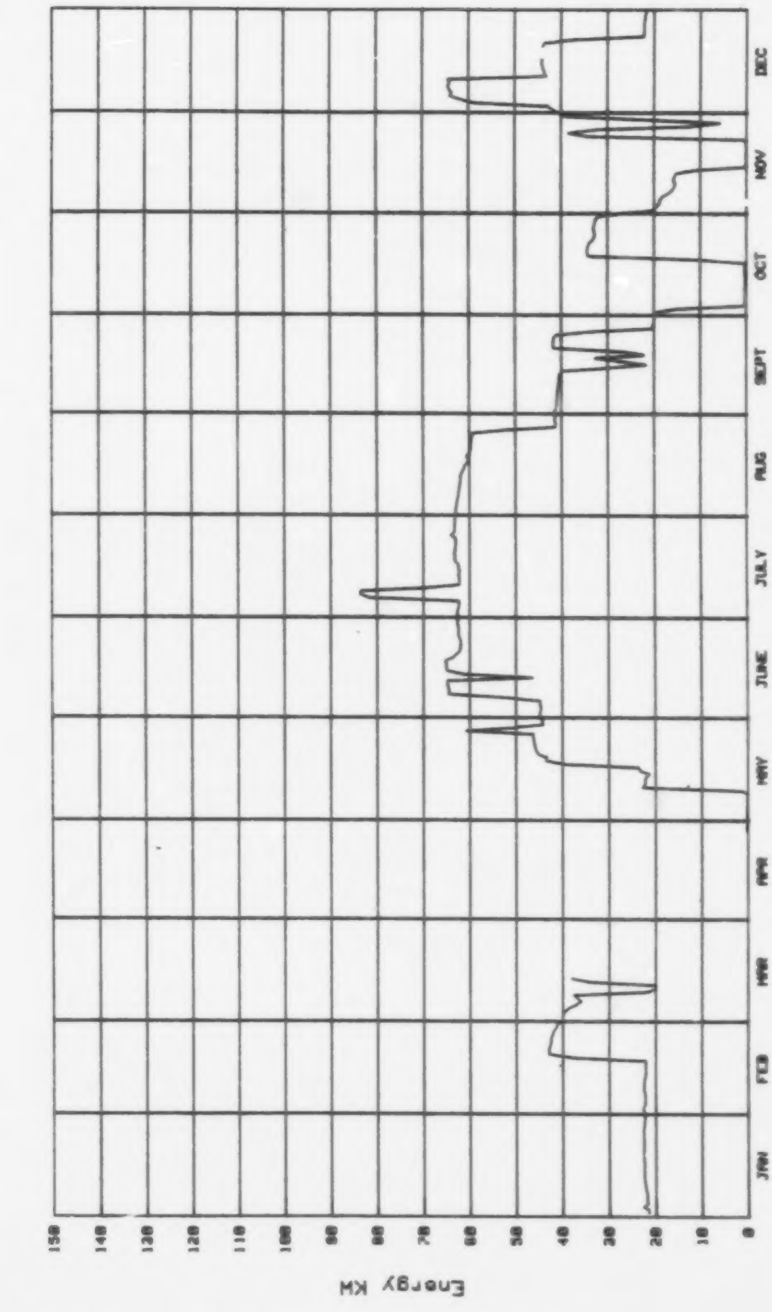


Figure 1.21-Average Daily Electrical Loads:
-Cold Seawater Recirculating Pumps (KW4)

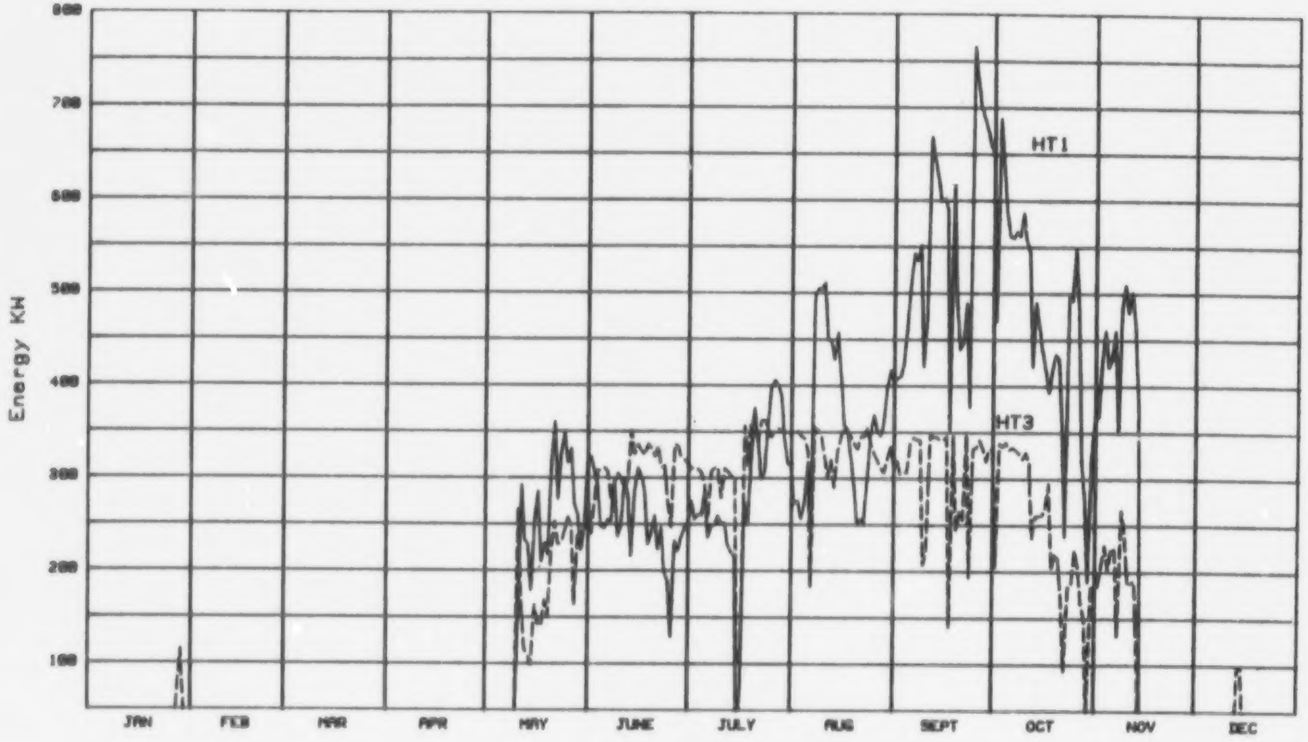


Figure 1.22-Average Daily Thermal Energy Extracted From Ocean Source
Seawater Supply:
-Across C.S.W.P.H.E. (HT1)
-Across H.P.E. (HT3)

The corresponding design conditions, for the maximum rates of thermal energy that could be extracted are:

- Through cold water plate heat exchanger (HT1) - 1,526 kw.
- Through heat pump evaporator (HT3) - 396 kw.

2. Thermal Energy Output

Average daily rate of thermal energy output by the heat pump (HT4) is shown in Figure 1.23.

The corresponding maximum output rate 579 kw.

3. Heat Pump Cooling vs Electrical Loads

Average daily heat pump cooling loads (HT3) of Ocean Source Seawater Supply to C.S.W.D.L.P. system, versus the corresponding heat pump electrical loads (KW2), are shown in Figure 1.24.

The Corresponding maximum design conditions were:
- Heat pump cooling load (HT3) - 396 kw.
- Heat pump electrical load (KW2) - 205.2 kw.

The projected ration of HT3/KW2 = 1.93, that is; for every KW of electrical energy input for operation of the heat pump, 1.93 KW of thermal energy is to be removed from the ocean source seawater supply (Q1).

4. Heat Pump Thermal Output vs Electrical Loads

Average daily thermal energy rate output (HT3) vs. corresponding electrical load (KW2), by the heat pump, are shown in Figure 1.24.

The corresponding maximum design conditions were

- Thermal energy output by the heat pump (HT4) - 579 kw.
- Electrical load by the heat pump (KW2) - 205.2 kw.

The projected ration of HT4/KW2 = 2.822, that is, the projected Coefficient of Performance (C.O.P) for the heat pump was 2.822.

Calculated average daily C.O.P. is shown in Figure 1.26.

5. Thermal Energy Extracted vs. Thermal Energy Output

Comparison of the average daily thermal energy rates; extracted from Ocean Source Seawater Supply (HT3) versus corresponding output (HT4), by the heat pump, is shown in Figure 1.27.

The corresponding maximum design projected rates were:

- Rate of thermal energy extracted (HT3) - 396 kw.
- Rate of thermal energy output (HT4) - 579 KW.

The projected ratio HT4/HT3 = 1.462, that is; the rate of thermal energy output was projected at 1.462 times the rate of the thermal energy extracted from the ocean source seawater supply - by the heat pump.

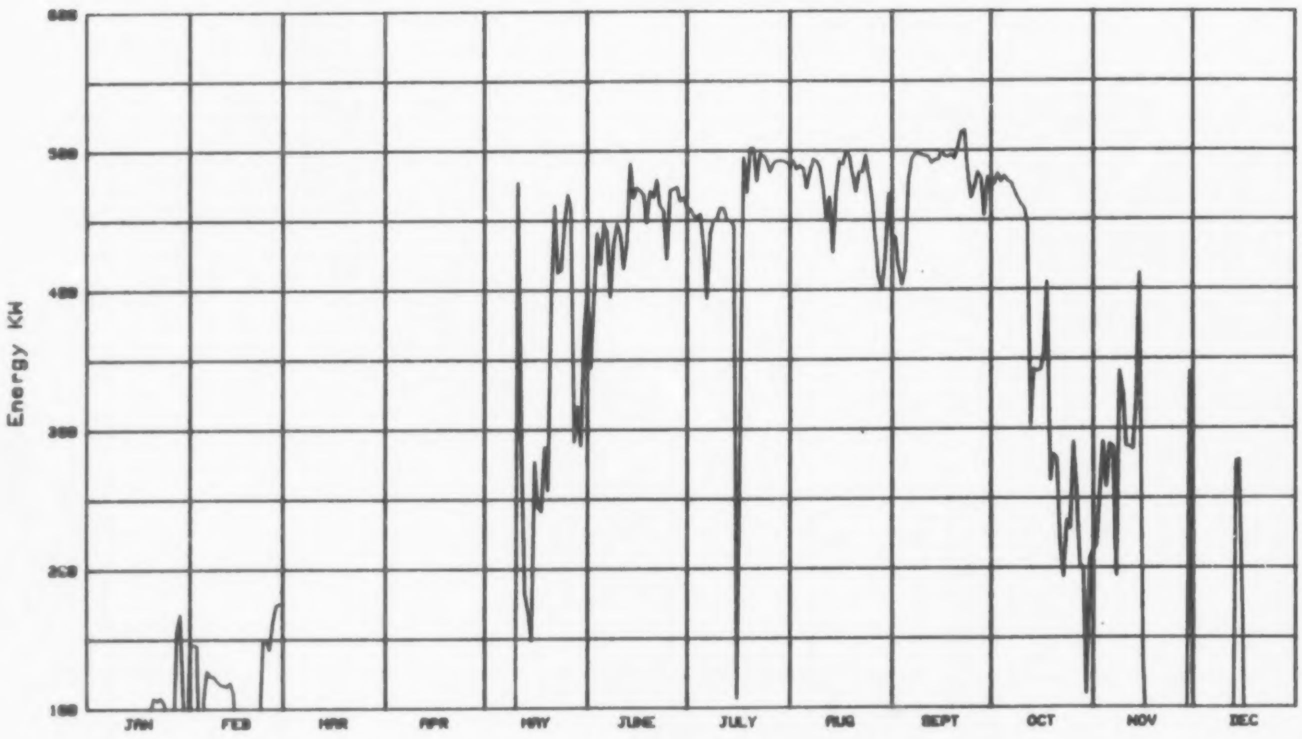


Figure 1.23-Average Daily Thermal Energy Output By Heat Pump (HT4)

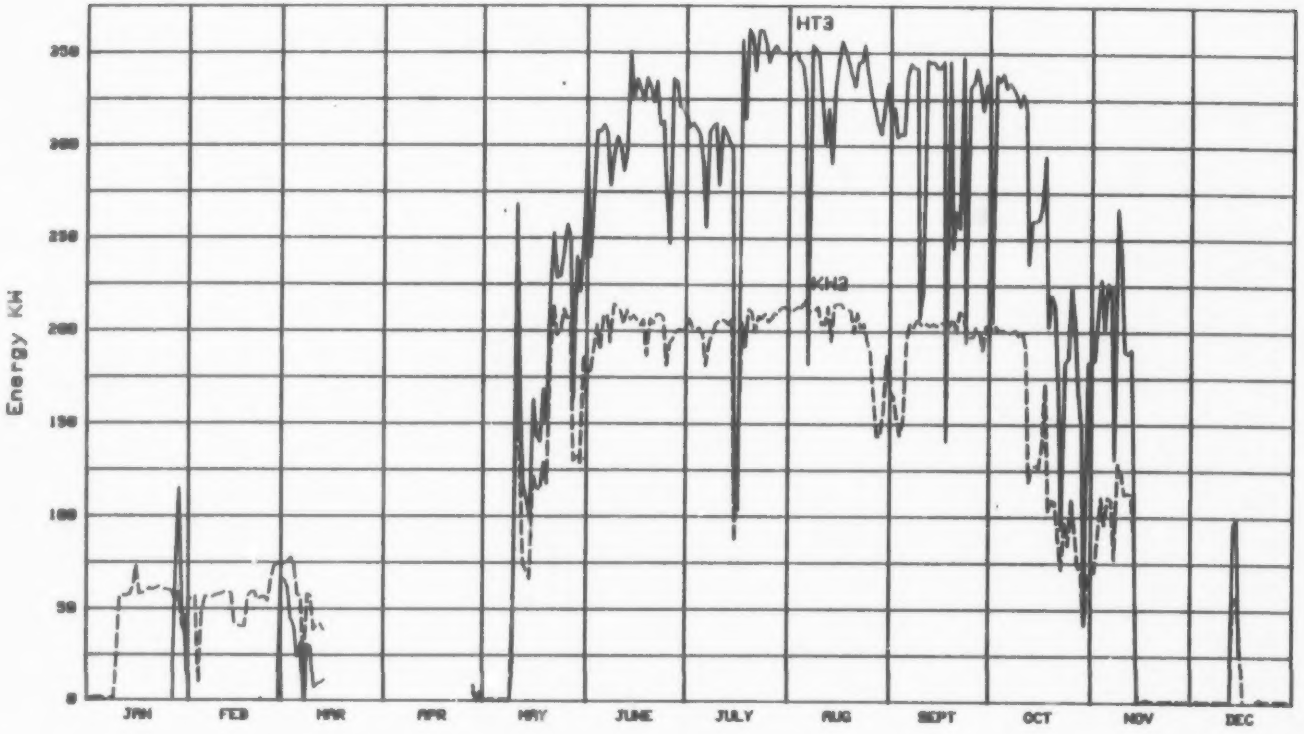


Figure 1.24–Average Daily Relationship of Energy Supply/Demand:
-Thermal Energy Extracted From Ocean Source Seawater Supply Across H.P.E.
-Electrical Load of Heat Pump Compressors (KW2)

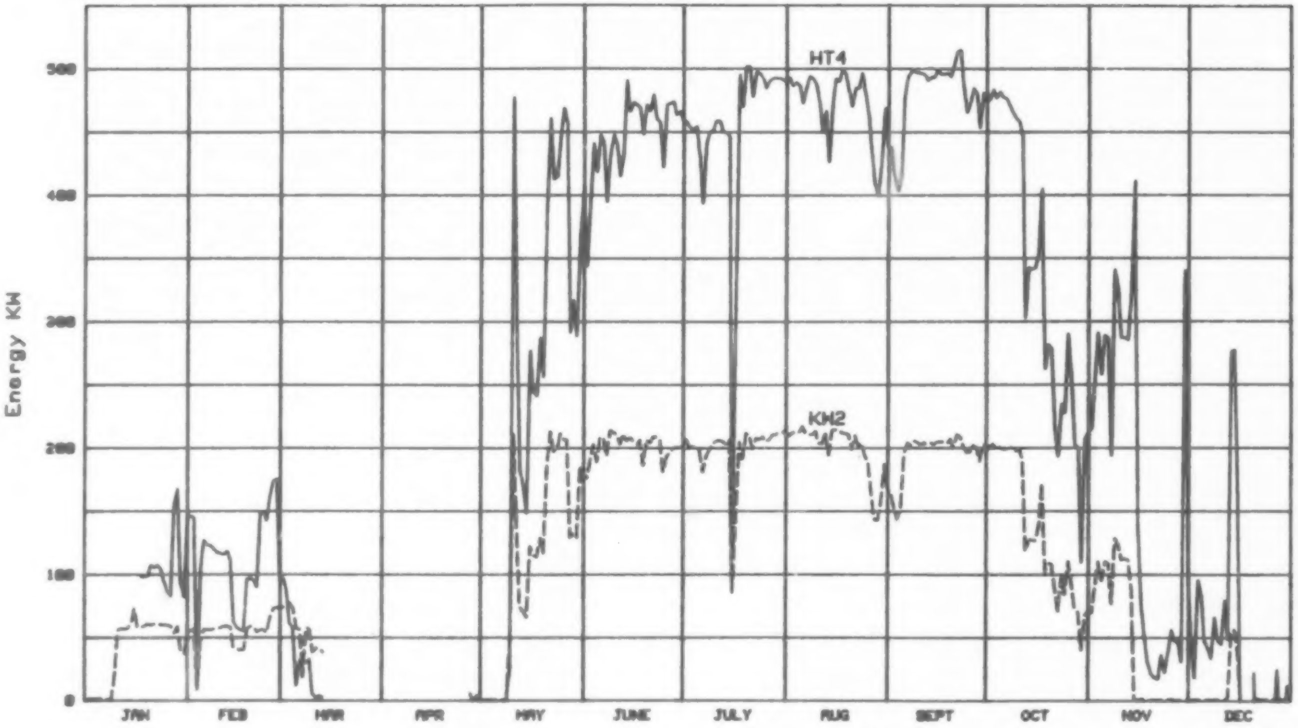


Figure 1.25–Average Daily Relationship of Energy Supply/Demand:
-Thermal Energy Supplied by Heat Pump (HT4)
-Electrical Load of Heat Pump Compressors (KW2)

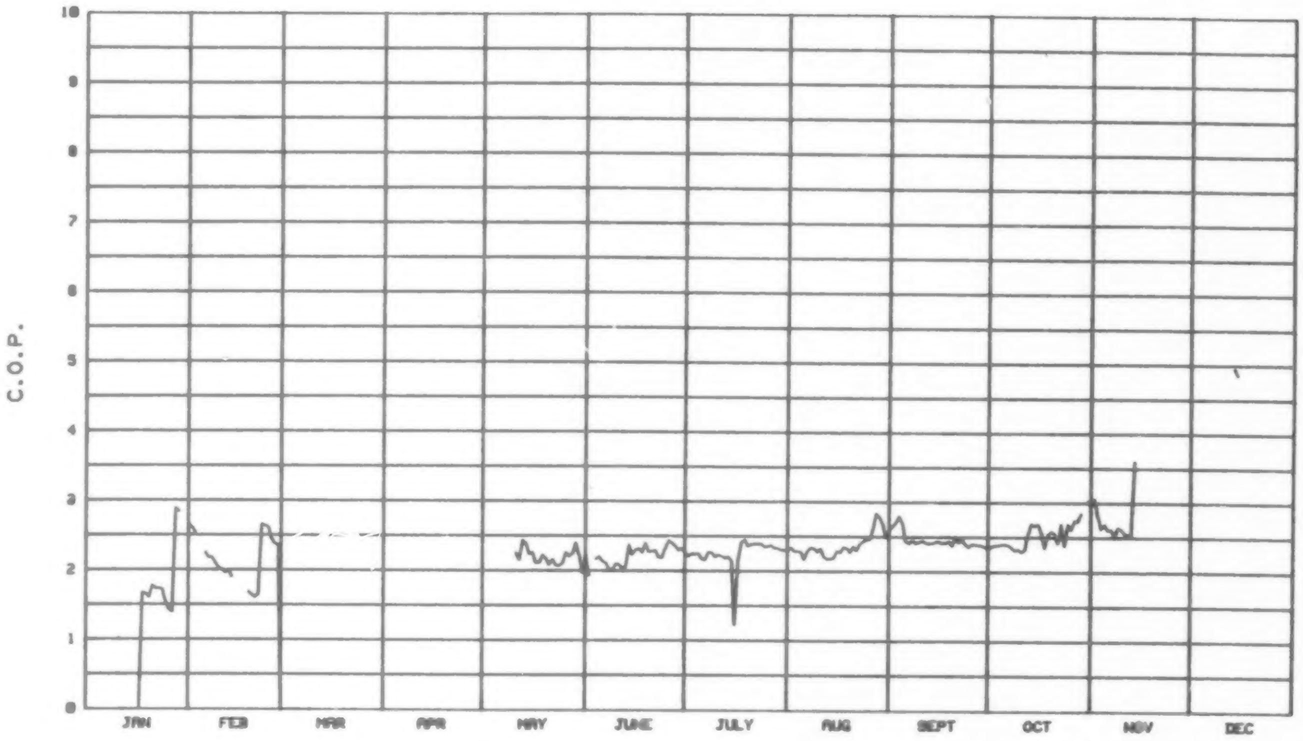


Figure 1.26-Average Daily Coefficient of Performance (HT4/KW2) of Heat Pump

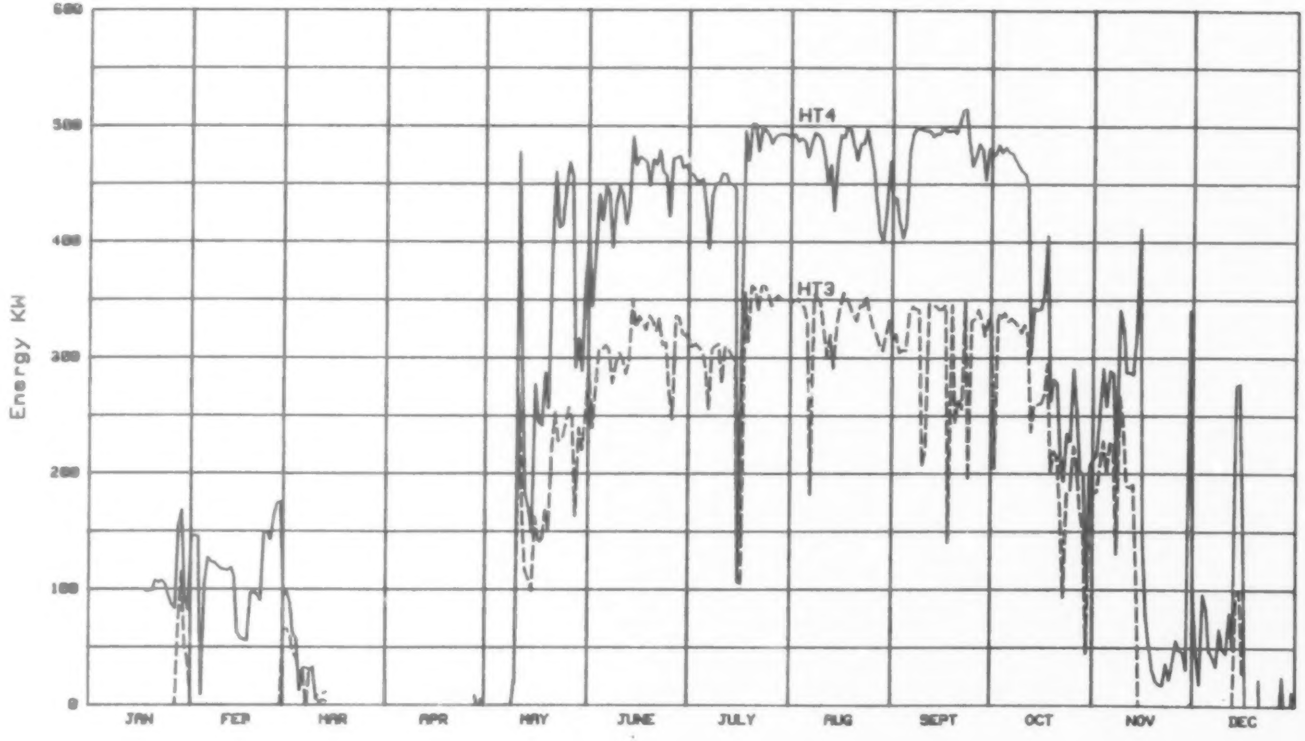


Figure 1.27-Average Daily Thermal Energy Supply Relationship:
-Extracted From Ocean Source Seawater Supply Across H.P.E. (HT3)
-Supplied by Heat Pump Across H.P.E (HT4)

6. Demand Cooling Loads

The demand cooling load rate of the system is made up of:

- Approach thermal energy (HT12) at C.S.W.P.H.E., that is the product of temperature difference (T5 - T3) and flow rate Q1.

- Thermal energy (HT11) gain by the recirculated cold seawater through C.S.W.D.L.P. system, which is equal to the product of temperature difference (T3 - T6) and flow rate Q1.

Comparison of the average daily thermal cooling energy rate demand, by the approach load (HT12) and gain through C.S.W.D.L.P. (HT11), is shown in Figure 1.28.

The corresponding maximum projected (design) rates were:

- Approach thermal cooling load (HT12) - 223.6 kw.
- Thermal gain through C.S.W.D.L.P. (HT11) - 161.9 kw.

Under normal steady state, i.e., T11 = 4°C, the total demand cooling load rate (HT11 + HT12) is equal to the rate of thermal energy extracted by the heat pump from the ocean source seawater supply (HT3), that is:

$$HT3 - (HT11 + HT12) = 0$$

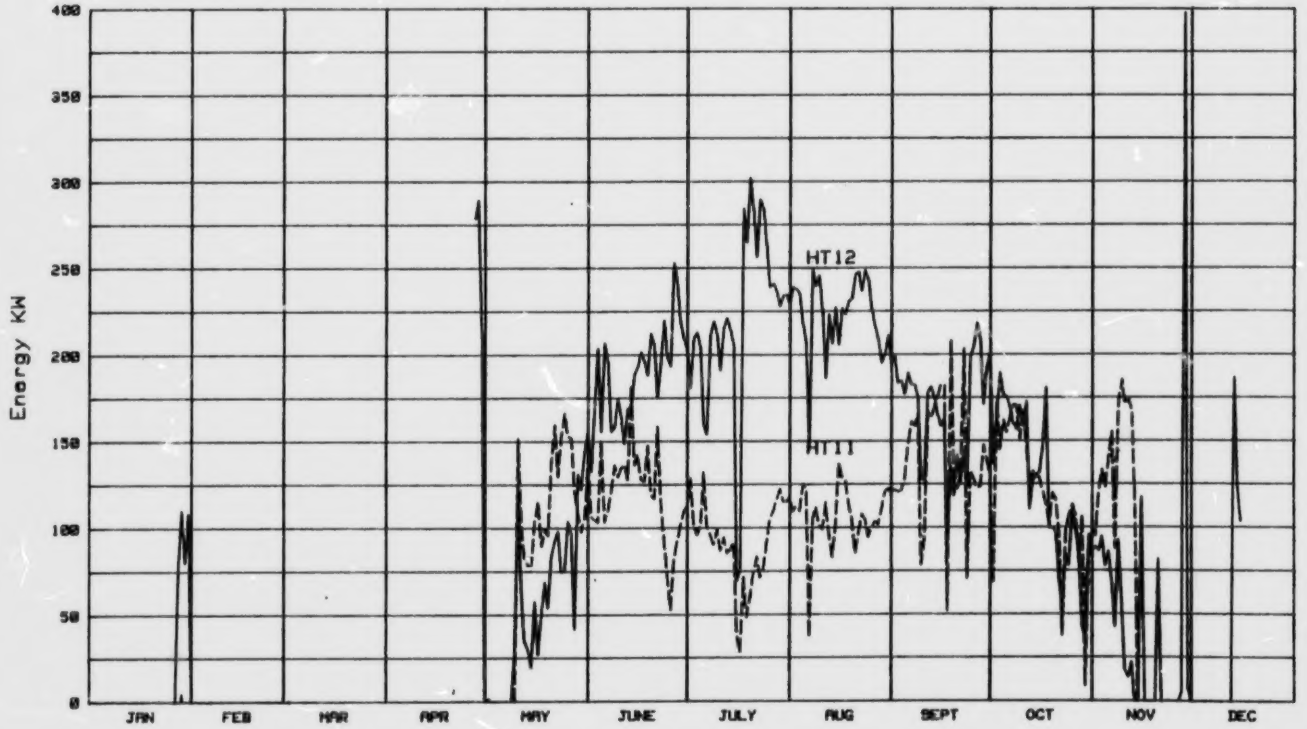


Figure 1.28-Average Daily Thermal Loads:
-Approach Thermal Load at C.S.W.P.H.E. (HT12)
-Thermal Load Gain Through C.S.W.D.L.P. (HT11)

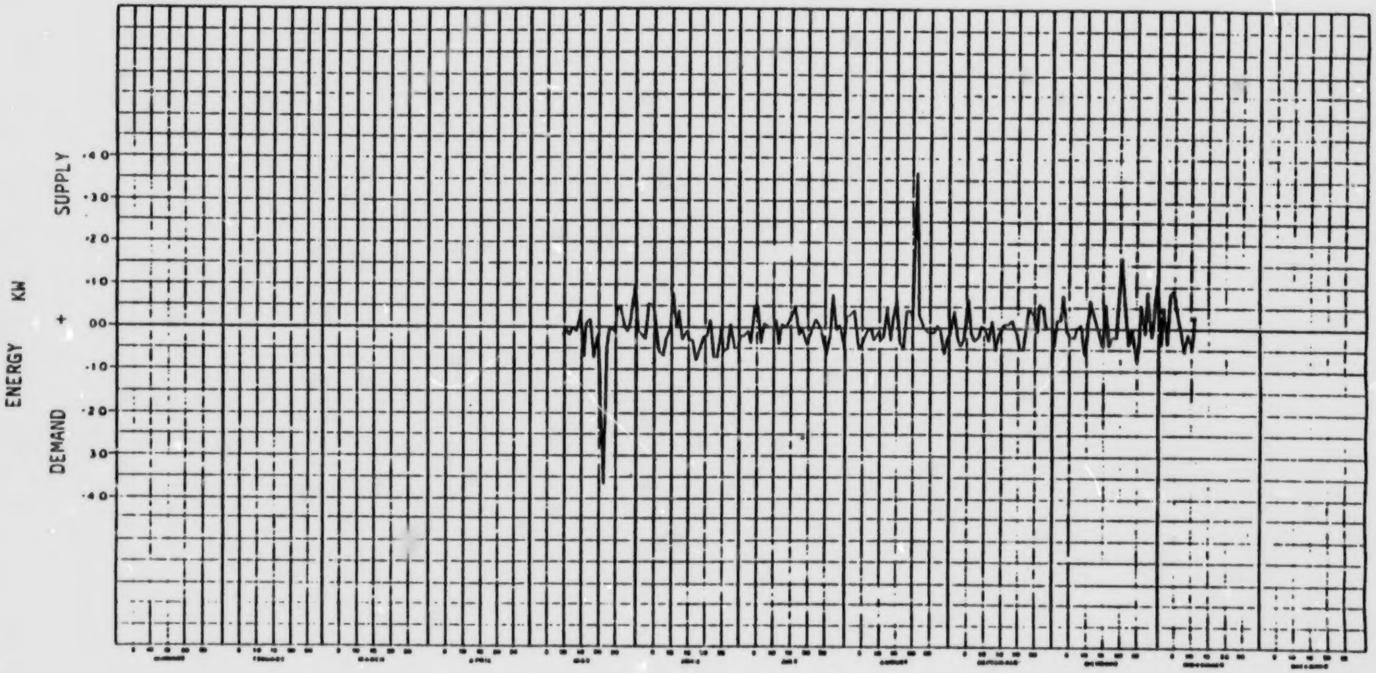


Figure - 1.29 - Average Daily Relationship of Thermal Energy Balance Variation [HT3 - (HT11 + HT12)]

- Supply : Energy Extracted From Ocean Source Seawater Supply (HT3)
- Demand : Energy Load By The System (HT11 + HT12)

Calculated average daily variation of the system demand cooling load vs. cooling capacity supplied by the heat pump, is shown in Figure 1.29.

1.6 Operational Monitored Results

Daily log of the operation has identified the following difficiencies of the system.

A. Temperature Control

The required operating temperature (T11) of 4°C for the C.S.W.D.L.P. system could not be maintained at design flow rate of the ocean source seawater supply (Q1). To maintain T11 at, or near, its designed condition of 4°C, it was frequently required to:

- Reduce the flow rate of the ocean source seawater supply (Q1); or,
- Eliminate the make-up of the ocean source seawater supply (Q1) and recirculate the water from the C.S.W.D.L.P. system through the heat pump evaporator.

The above modes of operation were required more frequently during the period of warm and sunny atmospheric conditions, i.e., from the later part of June to the later part of August. It was significantly improved once the Old (pioneer) Dryland Pound Room was removed from the system.

Additional operational problems that had negative effects on controlling C.S.W.D.L.P. system temperature are:

1. Frequently the heat pump would operate at a partial load, although the temperature of the C.S.W.D.L.P. system was above 4°C and rising. This condition was also more frequently noted during the period of warm and sunny atmospheric conditions.

2. Frequent electrical supply outings have resulted in:
    a) Shut-down of the heat pump for extended periods, and/or,
    b) Injection of ocean source seawater supply, at ambient temperature (T1), into the C.S.W.D.L.P. system; which resulted in the rise of the operating temperature (T11) of the C.S.W.D.L.P. system.

3. Fouling of the C.S.W.D.H.E., due to influx of foreign materials (seaweed and/or debris) or due to marine type growth on the surface of the heat exchanging plates and tubes.

B. Flow Rates

Design flow rates for:

- Q1 of 37.8 l/s; and
- Q2 of 34.7 l/s;

were only achieved for a short period after commissioning of the system.

During operational period from May 10, 1985 to November 12, 1985 the maximum achieved corresponding flow rates were:

- Q1 of 29.073 l/s on May 31, 1985; and
- Q2 of 27.298 l/s on June 1, 1985,

after thorough cleaning of the C.S.W.P.H.E.

Influx of seaweed and debris into the system and rapid rate of marine growth within the C.S.W.P.H.E. surfaces resulted in differential pressure rise across C.S.W.P.H.E. and H.P.E. and correspondingly, a decline in flow rates of Q1 and Q2.

Typical effect of the seaweed influx and marine growth on the differential pressure across C.S.W.P.H.E. are shown in Figure 1.30.

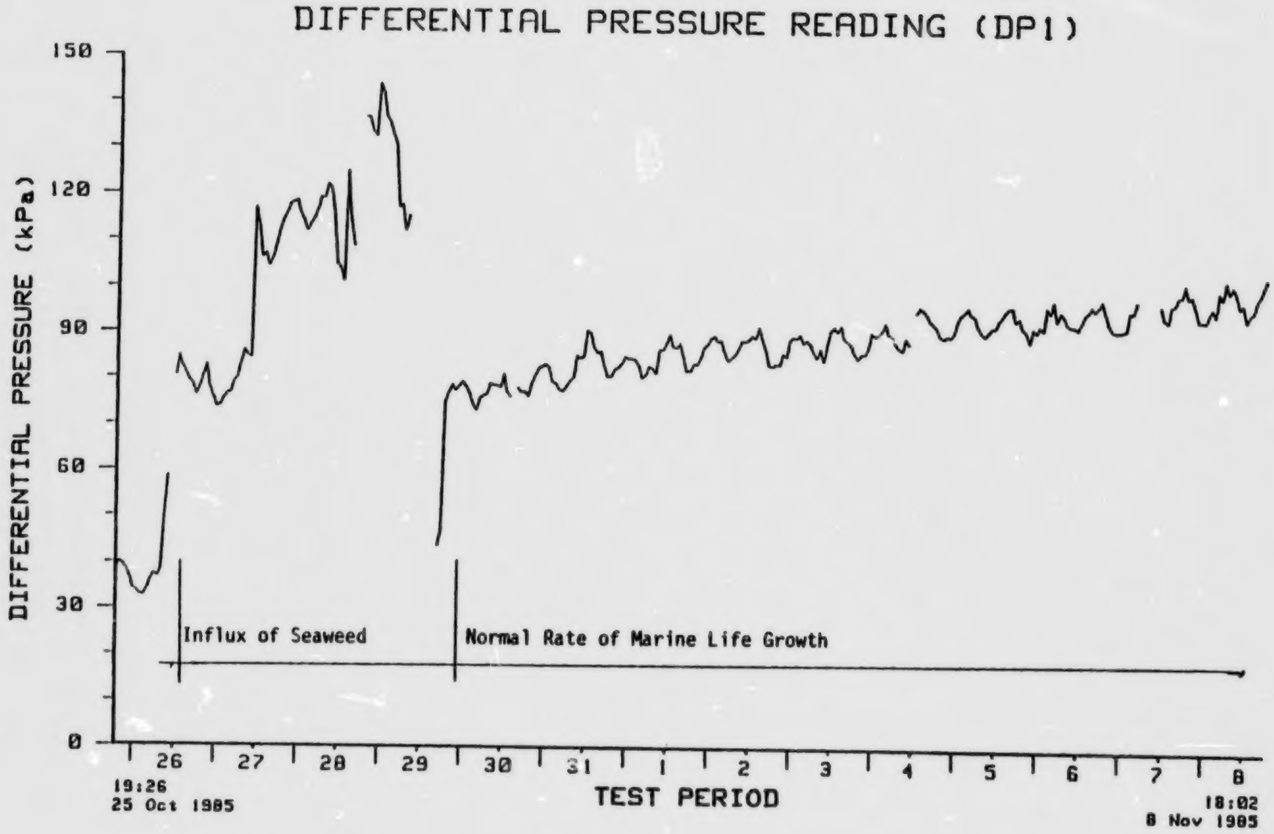


Figure 1.30 - Effect of Seaweed influx and marine life growth on the Differential Pressure across Ambient side of Cold Seawater Plate Heat Exchanger.

Frequently, ocean source seawater supply flow rate (Q1) was reduced to compensate for the declining flow rate of cold waste seawater (Q2) due to differential pressure rise across C.S.W.P.H.E. and W.H.P.H.E. This rapid differential pressure rise was mainly due to experienced rapid biological growth, from the cold waste seawater, on the surfaces of the heat exchanging plates.

Typical effect of the biological growth on the differential pressure rise in the cold waste seawater stream, across the C.S.W.P.H.E., is shown in Figure 1.31.

During the later part of the monitoring period, this problem was somewhat alleviated through injection of cholorine into the cold waste seawater stream.

Similar problems with seaweed influx and marine growth, as shown in Figure 1.30, were experienced with Warm Seawater Plate Heat Exchanger (W.S.W.P.H.E.).

There were no encountered problems in maintaining flow rates of the fresh water recirculating streams - Q3 and Q4.

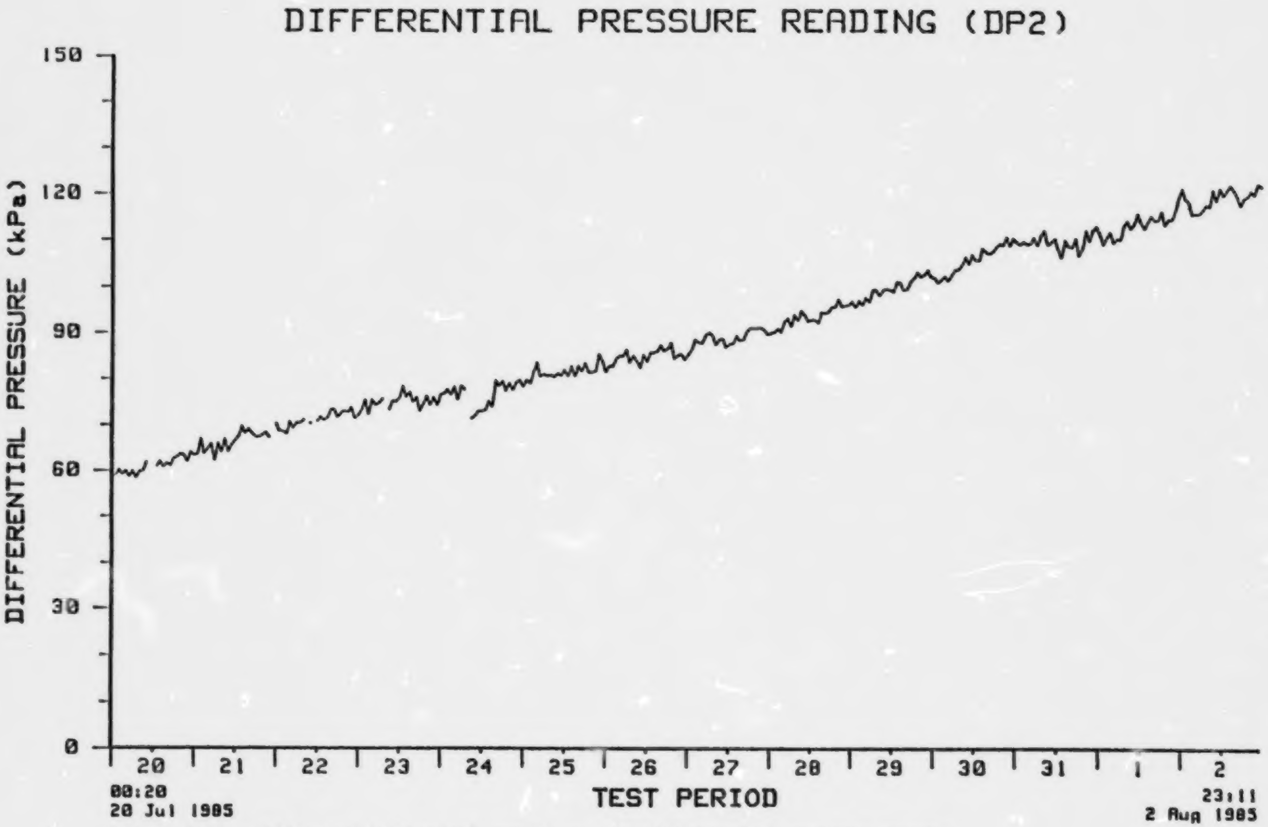


Figure 1.31 - Effect of biological growth on the differential pressure across waste seawater side of cold seawater side of Cold Seawater Plate Heat Exchanger.

C. Supply Pressures and Differential Pressures

Existing ocean source seawater and cold waste seawater supply pumps do not have adequate discharge pressure to achieve and maintain the required flow rates (Q1 and Q2) due to increased differential pressure across C.S.W.P.H.E., H.P.E., W.H.P.H.E., and W.S.W.P.H.E.

As indicated in the preceeding section, differential pressure rises were mainly due to:

1. Influx of seaweed and debris through the ocean source seawater supply (Q1).
2. Marine growth on the heat exchanging surfaces in the ocean source seawater supply stream.
3. Biological growth on the heat exchanging surfaces in the cold waste seawater stream.

There were no problems encountered with supply pressures, and/or differential pressures in the cold seawater recirculation stream and fresh water recirculation stream.

D. Electrical Power Supply

There were frequent outings in the utility supplied electrical energy to the facility. Although the facility is equipped with a stand-by diesel generator, it does not have adequate generating capacity to supply the required electrical energy for maintaining the operation of all the equipment and services within the facility, including the heat pump.

As noted in Section 1.6 (A), prolonged power outings normally result in a temperature rise of the cold recirculated seawater in the system.

E. EQUIPMENT

Noted operational problems with the various pieces of equipment are as follows:

1. Seawater Supply Pumps (S.W.S.P.)

With the exception of inadequate discharge pressure, to compensate for increased pressure drops through the system, these units have been operating satisfactorily. Problems usually encountered, in similar installatons; corrosion, cavitation, have been minimal or nonexistent.

The original packing-gland type shaft seals have been replaced with mechanical type shaft seals resulting in less frequent maintenance.

2. Waste Seawater Pumps (W.S.W.P.)

As is the case with the S.W.S.P., these pumps also do not have adequate discharge pressure to maintain flow rates with increased pressure drops through the system.

In addition, it has been noted that these pumps:

a) Require frequent maintenance and/or replacement of outboard bearings and extended shaft.

b) Have a high rate of corrosion.

2. Seawater Circulating Pumps (S.W.C.P.)

Although these pumps possess the required discharge pressure, the operational problems encountered with these pumps are:

a) Too Frequent maintenance and/or replacement of outboard bearing and extended shaft.

b) Very high rate of corrosion.

c) Subject to vibration and cavitation at low discharge pressures.

4. Hot Water Recirculating Pumps (H.W.R.P.)

These pumps have been performing satisfactorily. There were no operational problems encountered and the maintenance requirements have been on the level normally expected.

5. Seawater Return Pumps (S.W.R.P.)

There were no operational problems encountered with these pumps. The maintenance problems encountered are:

a) Too frequent maintenance and replacement of outboard bearings and the extended shaft.

b) High rate of corrosion.

6. Cold Seawater Plate Heat Exchanger (C.S.W.P.H.E.)

The operational problems encountered with C.S.W.P.H.E., are:

a) Frequent plugging of the flow passages due to influx of seaweed and debris from the ocean source seawater supply.

b) Rapid build-up of marine growth on the heat exchanging surfaces, on both; ocean source seawater and cold waste seawater sides.

c) Rapid biological growth on the cold waste seawater side of the heat exchanging surfaces.

The above operational problems resulted in continuous rise of differential pressure, reduced flow rates, reduced rates of energy transfer, and the requirement for frequent cleaning of the unit.

Maintenance requirements, other than cleaning, have been minimal.

Mild steel frame and compression screw are subject to corrosion in the seawater environment and require regular schedule of cleaning and application of protective coatings.

7. Waste Heat Plate Exchanger (W.H.P.H.E.)

The operational problem encountered has been mainly due to the rapid biological growth on the cold waste seawater side of the heat exchanging surfaces, resulting in:

a) Above normal operating differential pressure.
b) Reduced thermal energy transfer performance.

The maintenance requirements have been minimal.

8. Warm Seawater Plate Heat Exchanger (W.S.W.P.H.E.)

The operational problem experienced with this unit are identical to those described for C.S.W.P.H.E. unit, i.e., influx of seaweed and debris and build-up of marine growth.

9. Waste Seawater Heat Recovery Plate Heat Exchanger (W.S.W.H.R.P.H.E.)

There were no noticeable operational or maintenance problems experienced with this unit.

10. Heat Pump

Operational problems experienced with the heat pump unit are:

a) Fouling of the shell-and-tube evaporator due to influx of seaweed, with ocean source seawater supply, and build-up of marine growth.

b) Inadequate load control. The cooling load thermostat senses the temperature of the ocean source seawater supply (T6) leaving the heat pump evaporator. In many instances, and particularly during warm and sunny atmospheric conditions, the heat pump in the automatic mode would operate at partial load, even though the operating temperature of the system (T11) would be rising.

To alleviate this condition, operators are required to manually operate the unit at its full rated capacity.

c) Frequent electrical power outings, and more frequent power flicks, resulted in loss of compressor starts. The microprocessor control allows for three consecutive "hot-starts", of the compressors motors. Once these starts have been used up through electrical power outings and flicks, the drive compressor motor is idle until it cools off and can be restarted.

d) Refrigerant liquid level indicator is not very reliable. The existing Refrigeration Code has banned application of site glass on the refrigerant vessel~~s~~. The substitute type of indicators are not very reliable.

e) Heat Pump unit is not equipped with a refrigerant charge indicator. Low refrigerant charge results in reduced operating capacity of the heat pump unit.

The maintenance problems experienced, other than frequent cleaning of the shell-and-tube evaporator, are at the normal level, as normally associated with the refrigeration equipment.

11. Temperature Control of Recirculated Fresh Water

The excess thermal energy generated by the heat pump is rejected in the W.H.P.H.E. This unit is also designed to limit and maintain fresh water temperature (T8) leaving H.P.C. at 60°C.

The existing temperature (T8) control valve is a reverse-acting thermostatic expansion type. The problems experienced with this valve are:

a) Response too slow; resulting in continuous T11 temperature fluctuations.

b) Adjustments for T11 temperature changes are very cumbersum and time consuming.

1.7 Evaluation of Performance Results

Based on the monitored analytical and operational results, outlined in Sections 1.5 and 1.6 respectively, the performance results of the Heat Pump System, at Clearwater Lobsters Limited, Clark's Harbour, Shelburne County, Nova Scotia, have been analyzed and evaluated, for the period from May 11, 1985 to November 7, 1985 (26 Calendar weeks), and are summarized in the succeeding sections.

A. Analytical Performance

Weekly computer calculated performance data of:

- Thermal energy transfer rates;
- Electrical energy costs;

- Average cost of energy generated by the heat pump unit;
- Percent of generated thermal energy being utilized;
- Coefficient of Performance of the heat pump unit;
- Operating Logarithmic Mean Temperature Difference of the C.S.W.P.H.E.; and
- Operating Coefficient of Heat Transfer for the C.S.W.P.H.E.;

are shown in Tables H-31 through H-60, attached in Appendix 'H'.

Comparison of the maximum, minimum and average operational and design conditions are shown in Table 1-1.

Results of the performance are:

1. Temperatures (T11) maintained in C.S.W.D.L.P. system are:
    - Maximum - 6.85°C
    - Minimum - 3.5°C
    - Average - 4.77°C

   Maximum design temperature - 4.0°C
2. Discharge temperatures (T6) into C.S.W.R.R. from the heat pump evaporator are:
    - Maximum - 8.57°C.
    - Minimum - 1.6°C
    - Average - 3.06°C.

   Maximum design temperature - 3.1°C.
3. Approach temperatures differential (T5 - T3) at C.S.W.P.H.E. are:
    - Average - 1.29°C.

   Maximum design temperature - 1.45°C

TABLE 1-1: COMPARISON OF DESIGN AND MONITORED PERFORMANCE CONDITIONS OF THE HEAT PUMP SYSTEM AT CLARK'S HARBOUR, NOVA SCOTIA

No.	VARIABLE	UNITS	DESIGNED CONDITIONS MAX.	MIN.	AVE.	MONITORED CONDITIONS MAX.	MIN.	AVE.
1.	T1	C	15.5	6.2	11.7	15.68	6.6	10.57
2.	T3	C	4.15	--	--	10.54	3.68	5.02
3.	T4	C	14.9	--	--	14.72	5.59	9.64
4.	T5	C	5.6	--	--	11.65	3.70	6.31
5.	T6	C	3.1	--	--	8.57	1.60	3.06
6.	T7	C	48.9	--	--	57.06	27.56	45.73
7.	T8	C	60.0	--	--	64.50	29.72	53.07
8.	T10	C	48.9	--	--	54.74	23.16	40.22
9.	T11	C	4.0	--	--	6.85	3.5	4.77
10.	T1 - T5	C	9.9	--	--	--	--	4.26
11.	T5 - T6	C	2.5	--	--	--	--	3.25
12.	T5 - T3	C	1.45	--	--	--	--	1.29
13.	T3 - T6	C	1.05	--	--	--	--	1.96
14.	T8 - T7	C	11.1	--	--	--	--	7.34
15.	T8 - T10	C	11.1	--	--	--	--	12.85
16.	P1	kPa	--	--	360.0	316.6	216.1	286.0
17.	P2	kPa	--	--	195.0	215.9	82.4	150.5
18.	P3	kPa	--	--	270.0	266.6	57.3	230.4

TABLE 1-1: COMPARISON OF DESIGN AND MONITORED PERFORMANCE CONDITIONS OF THE HEAT PUMP SYSTEM AT CLARK'S HARBOUR, NOVA SCOTIA

			DESIGNED CONDITIONS			MONITORED CONDITIONS		
No.	VARIABLE	UNITS	MAX.	MIN.	AVE.	MAX.	MIN.	AVE.
19.	DP1	kPa	--	--	90.0	126.1	13.0	70.0
20.	DP2	kPa	--	--	90.0	199.0	21.7	81.3
21.	DP3	kPa	--	--	128.0	119.8	17.3	63.1
22.	DP4	kPa	--	--	35.0	43.4	16.6	39.1
23.	DP5	kPa	--	--	103.0	--	--	54.4
24.	Q1	1/s	37.8	--	--	28.3	7.8	21.6
25.	Q2	1/s	34.7	--	--	27.3	6.9	20.2
26.	Q3	1/s	12.7	--	--	14.2	5.8	13.6
27.	Q4	1/s	12.7	--	--	8.1	3.4	6.9
28.	Q5	1/s	6.3	--	--	6.3	1.7	4.1
29.	KW1	kw	22.8	--	--	71.0	57.8	61.3 (1)
30.	KW2	kw	205.2	--	--	217.5	66.3	178.1
31.	KW3	kw	13.3	--	--	15.0	6.0	10.7
32.	KW4	kw	74.7	--	--	83.5	--	49.2 (2)
33.	KW5	kw	5.7	--	--	6.9	2.9	6.7
34.	HT1	kw	1,526.0	--	--	489.1	--	372.0
35.	HT3	kw	396	--	--	361.9	--	284.9
36.	HT4	kw	570	--	--	541.7	--	416.6

TABLE 1-1: COMPARISON OF DESIGN AND MONITORED PERFORMANCE CONDITIONS OF THE HEAT PUMP SYSTEM AT CLARK'S HARBOUR, NOVA SCOTIA

			DESIGNED CONDITIONS			MONITORED CONDITIONS		
No.	VARIABLE	UNITS	MAX.	MIN.	AVE.	MAX.	MIN.	AVE.
37.	HT5	kw	590	--	--	447.5	141.4	370.2
38.	HT11	kw	161.9	--	--	302.2	--	172.7
39.	HT12	kw	223.6	--	--	209.8	--	127.8
40.	EC1	$/D	28.34	--	--	79.58	64.78	68.70 (3)
41.	EC2	$/D	255.04	--	--	243.77	74.31	199.61 (3)
42.	EC3	$/D	16.54	--	--	16.81	6.72	11.99 (3)
43.	EC4	$/D	104.48	--	--	93.59	--	53.69 (3)
44.	EC5	$/D	7.09	--	--	7.73	3.25	7.51 (3)
45.	TEC	$/D	411.49	--	--	441.48	149.06	341.5 (3)
46.	HPEC	$/KWH	0.0184	--	--	--	--	0.020 (4)
47.	PHU	%	78.1	--	--	36.2	5.5	14.7 (5)
48.	COP	--	2.822	--	--	3.06	2.11	2.36
49.	LMTD	C	0.96	--	--	2.12	0.62	1.20
50	U	$\frac{KW}{m^{2}\,{}^{0}C}$	4.59	--	--	1.80	0.57	0.88

NOTES:

(1) Includes pumping of ambient seawater for the remaining facility requirements.
(2) Does not include cold seawater recirculating pumps added in Phase II.
(3) Based on the average electrical energy cost for the facility of \$0.0467/KWH, see Table I-4, Appendix I.
(4) Based on (KW2/HT4) X \$0.0467/KWH.
(5) Generated thermal energy was used only for raising the temperature of the ocean source seawater supply to W.S.W.D.L.P. laboratory.

4. Temperature differentials (T3 - T6) are:

   - Average - 1.96°C.,

   Maximum design temperature - 1.05°C.

5. Discharge temperature (T8) from the H.P.C. are:

   - Maximum - 64.5°C.
   - Minimum - 29.72°C.
   - Average - 53.07°C.

   Maximum design temperature - 60.0°C.

6. Cooling loads:

   a) Approach cooling load (HT12) are:

      - Maximum - 209.8 kw,
      - Average - 172.7 kw,

      Maximum design thermal energy gain (HT12) - 223.6 kw.

   b) Thermal energy gain loads (HT11) are:

      - Maximum - 302.2 kw,
      - Average - 172.7 kw,

      Maximum design thermal energy gain (HT11) - 161.9 kw.

7. Thermal energy extracted from seawater is:

   a) At C.S.W.P.H.E. (HT1):

      - Maximum - 489.1 kw.
      - Average - 372.0 kw.

      Maximum design (HT1) - 1,526 kw.

b) At H.P.E. (HT3):

- Maximum - 361.9 kw.
- Average - 284.9 kw.

Maximum design (HT3) - 396 kw.

8. Thermal energy generated by heat pump (HT4):

- Maximum - 514.7 kw.
- Average - 416.6 kw.

Maximum design (HT4) - 579 kw.

9. Heat pump electrical load (KW2):

- Maximum - 217.5 kw.
- Average - 178.1 kw.

Maximum design load (KW2) - 205.2 kw.

10. Thermal energy extracted from seawater by the heat pump per unit electrical load of the heat pump (HT3/KW2) - 1.90

11. Thermal energy output by the heat pump per unit electrical load of the heat pump (HT4/KW2):

- Average - 2.36.

Maximum design (HT4/KW2) - 2.822.

12. Coefficient of Performance (C.O.P.):

- Maximum - 3.06
- Average - 2.36

Maximum design (C.O.P.) - 2.822.

13. Cost of thermal energy produced by the heat pump (H.P.E.C.):

- Average - $0.020 KWH.

14. Relative cost of thermal energy produced by the heat pump to:

a) Electrical resistance heating:

- Average - 1/2.335 (1)

Maximum design - 1/2.822 (2)

b) Combustion of No. 2 fuel oil::

- Average - 1/2.044 (3)

Maximum design - 1/2.044 (4)

(1) Based on 1985 average electrical energy cost to the facility of $0.0467/KWH

(2) Based on 1984 average electrical energy cost to the facility of $0.0518/KWH.

(3) Based on 1985 No. 2 fuel oil cost to the facility of $0.395/l.

(4) Based on 1983 No. 2 fuel oil cost to the facility of $0.315/l.

B. Operational Results

Based on the monitoring and operational data - Sections 1.5 and 1.6, and performance data - Section 1.7(A), the operational results of the monitoring program and the Heat Pump Performance are as follows:

1. Monitoring Program:
    - a) Monitoring equipment and data logging system have performed as projected.
    - b) Adequate data have been collected for the assessment and evaluation of the heat pump equipment and the system performances.
    - c) Program did not include equipment and data logging system for the assessment and evaluation of the biological performance of the system.

2. Heat Pump Performance:
    - a) Cold Seawater temperature (T11) for the Cold Seawater Dryland Pound System could not be maintained at designed condition of 4°C, due to:
        - (i) Plugging and fouling of the Cold Seawater Plate Heat Exchanger.
        - (ii) Frequent electrical power supply outings.
        - (iii) Lower than projected peak cooling capacity of the heat pump - by 8.6%.

(iv) Lack of temperature control relationship of cold waste seawater and the heat pump operating load.

(v) Greater than projected thermal energy gain through the Cold Seawater Dryland Pound System - by 86.7%, mainly in the old dryland pound room.

b) Flow rates of ocean source seawater and cold waste seawater supplies operated far below design flow rates due to plugging and fouling of the heat exchangers and correspondingly higher operating differential pressures than projected.

c) Peak heat pump operating electrical load was greater than the design condition - by 6.0%.

d) Peak thermal energy output by the heat pump was less than the design condition - by 11.1%.

e) Average thermal energy extracted from seawater - by the heat pump, per unit electrical energy input - into the heat pump, was less than the maximum design condition - by 17.1%.

f) Average thermal energy output - by the heat pump, per unit electrical energy input - into the heat pump, was less than the design condition - by 16.4%.

g) Coefficient of Performance for the heat pump.

(i) Peak C.O.P. greater than the design condition - by 8.4%.

(ii) Average C.O.P. was lower than the design condition - by 16.4%.

h) Average cost of the thermal energy produced - by the heat pump, was greater than projected - by 8.7%.

i) Relative costs of produced thermal energy:

(i) In relation to electrical resistance heating is higher than the projected - by 20.9%.

(ii) In relation to combustion of No. 2 fuel oil is lower than the projected - by 13.1%.

2.0 FACILITIES PERFORMANCE

Overall performance of the facility, holding and maintaining of live lobsters in the cold seawater environment assisted by the installation of the heat pump, are detailed in the following sections.

2.1 Product Volumes and Rates

For the period of heat pump performance monitoring detailed in Chapter 1.0, weekly inventory of product holdings in:
- cold seawater (DLP1, DLP2 and DLP3),
- ambient seawater (Tank House), and
- warm seawater laboratory,

are shown in Table I-1, Appendix 'I'.

It shows the peak inventory holdings in:
- Cold seawater DLP's - 768,639 lbs during the week of July 5, 1985.
- Ambient seawater - 95,788 lbs during the week of May 31, 1985.
- Warm seawater laboratory - 1,019 lbs during the week of October 4, 1985.

Seasonal product inventory distribution is shown in Figures I.1, I.2 and I.3, Appendix 'I'.

For the period shown, total volume of product handled by the facility is 1.44 million lbs.

2.2 Electrical Energy Usage

The facilities total demand loads, consumption rates, and correspondingly, costs for the twelve month period - ending November 28, 1985 are shown in Table I-4, Appendix 'I'.

The peak monthly demand loads and usage volumes are:

- Demand load - 499.2 KVA for a 33 day period, ending July 30, 1985.
- Usage volume - 386,813 KWH for 33 day period, ending July 30, 1985.

The average monthly demand load and usage volumes are:

- Demand load - 369.6 KVA for a 12 month period ending November 28, 1985.
- Usage volume - 211,233 KWH for a 12 month period, ending November 28, 1985.
- Load Factor - 0.826 for a 12 month period, ending November 28, 1985.

The electrical energy costs for the 12 months period, ending November 28, 1985, are:

- Total electrical energy bill $118,286.10.
- Maximum monthly energy billing - $16,948.00 for 33 day period ending July 30, 1985.
- Average monthly billing - $9,857.00.
- Maximum average daily billing - $514.00 during a 33 day period, ending July 30, 1985.
- Average daily billing - $325.00.

The average electrical energy costs are:

- Per KWH of consumption - $0.0467.
- Per lb of product handled - $0.0496.

The originally projected electrical energy costs - for lthe period from May 30, 1985 to May 30, 1986,

- Per KWH of consumption - $0.518.
- Per lb of product handled - $0.067.

Therefore, energy costs achieved were:

- 9.8% less per KWH than originally projected.
- 26.7% less per lb of product handled than originally projected.

2.3 Biological Performance

A detailed report of biological results, through Phases I and II of development, and recommendations for the required operating conditions, modifications and further effort, are attached in Appendix 'J'.

Temperatures profile of cold seawater;

- entering dryland pound (T11), and
- leaving dryland pound (T3),

for the period from May 11, 1985 to November 11, 1985, are shown in Figure 1.9, Chapter 1.0.

Monitoring within each dryland pound room of:

- temperature changes of recirculated cold seawater,
- dissolved oxygen change of recirculated cold seawater, and
- nitrogen change within the recirculated seawater,

were not included in the heat pump monitoring program.

EXPERIMENTAL TRAYS

Forty-two experimental trays were set up in the Warm Seawater Dryland Pound Laboratory, of which:

- Twenty-one (one rack) experimental trays were arranged for heated seawater, and
- Twenty-one (one rack) experimental trays were arranged for ambient seawater.

Each experimental tray, arranged for heated seawater, had:

- 30 pcs. live lobster per tray, for a total of 660 pcs. at average weight of 0.75 lb/lobster.

Each experimental tray, arrangement for ambient seawater, had:

- 10 trays with 30 live lobsters per tray and 11 trays with 40 live lobsters per tray; for total of 1740 pieces at average weight of 0.75 lb/lobster.

Each rack, heated and unheated, had a seawater flow rate of 1.95 l/s per rack.

Therefore, the average flow rates for heated and unheated racks were:

Heated rack:

- 0.00295 l/s per lobster, or
- 0.00868 l/s per kg. of live lobsters.

Unheated rack:

- 0.00264 l/s per lobster, or
- 0.0074 l/s per kg. of live lobsters.

Weekly averages of:

- total volume of lobsters,
- temperature of heated seawater,

- temperature of ambient seawater,
- total seawater flow rate,
- seawater flow rate per rack, and
- energy consumption rates,

for the 42 experimental trays (2 racks X 21 trays per rack) are shown in Table 2-1.

Temperature profile of ambient and heated seawater for the 42 experimental trays is shown in Figure I.1, Appendix 'I'.

Due to lack of adequate instrumentation, oxygen and nitrogen levels in the two experimental racks could not be accurately determined.

TABLE 2-1: AVERAGE WEEKLY MONITORED CONDITIONS OF 42 EXPERIMENTAL TRAYS

WEEK	VOLUME	TEMP	C	FLOW	RATES-1/s	THERMAL ENERGY
ENDING	kg.	HTD	UNHTD	TOTAL	PER RACK	LOAD - kw.
19/07/85	308.3	15.8	11.3	4.7	2.35	43.1
26/07/85	400.8	15.0	10.1	4.7	2.35	47.0
02/08/85	384.5	17.0	10.2	4.8	2.4	66.6
09/08/85	416.3	18.3	10.7	4.5	2.25	69.8
16/08/85	416.3	18.3	11.5	3.8	1.9	52.7
23/08/85	406.8	18.5	10.7	4.0	2.0	63.6
30/08/85	402.7	16.5	10.6	3.8	1.9	45.7
06/09/85	401.8	17.5	11.9	3.3	1.55	35.4
13/09/85	392.7	20.5	14.7	3.6	1.8	42.6
20/09/85	389.5	21.0	15.1	3.9	1.95	46.9
27/09/85	388.2	20.2	15.2	3.8	1.9	38.8
04/10/85	462.6	18.8	14.9	3.2	1.6	25.4
11/10/85	399.1	17.5	13.1	3.9	1.95	35.0
18/10/85	383.2	17.5	11.2	3.5	1.75	45.0
25/10/85	383.2	10.5	10.4	2.9	1.45	0.6

ECONOMIC EVALUATION

The economic evaluation of the heat pump system will be based on the monitored analytical and operational results that have been gathered during the period May 11, 1985 to November 7, 1985 (26 calendar weeks). This information will then be compared to capital costs and actual savings to evaluate the economic viability of the heat pump system.

The total capital cost of the heat pump system is $481,840. A breakdown of this cost is illustrated in Table B-12. This breakdown will include costs for the building, mechanical and electrical systems specifically related to the heat pump.

A comparison of the Clearwater heat pump with a residential or commercial heat pump is useful at this point.

The Clearwater heat pump system utilizes the full potential of a heat pump system in that it uses both the cooling and heating capabilities simultaneously. The evaporation cools seawater to the dryland pound while at the same time the condensor heats freshwater that will be used in the hot water heating and domestic water systems.

The residential or commercial heat pump system extract energy from a source, at the evaporator, and deliver the energy to a sink, via the condenser. The media from the heat source is no longer used, it is returned directly to the source. (See Figure 1.32).

Therefore, when determining the overall C.O.P. of the Clearwater heat pump systems, we must add; the work done by the evaporators and the work done by the condenser, and divide this by the work done at the compressors.

The easiest method of establishing the economic viability of this heat pump system will be the calculation of the simple pay back period, that is:

$$\text{PAYBACK PERIOD} = \frac{\text{TOTAL CAPITAL COST}}{\text{ANNUAL SAVINGS - ANNUAL OPERATING COSTS.}}$$

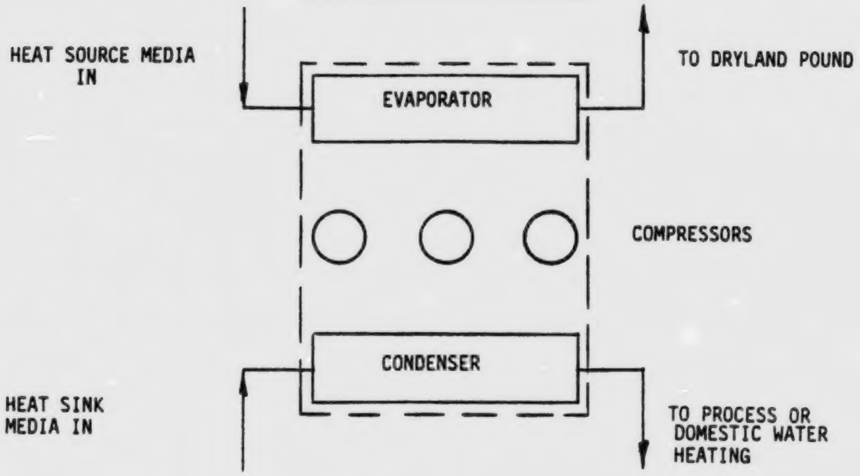
Table B.12 gives the breakdown of the heat pump systems costs. Table B.13 gives a breakdown of the savings and operating costs based on the 1985 prices paid for electricity and fuel oil (see Table I-4 and Table B-11).

Therefore the simple payback is:

$$\text{PAYBACK PERIOD} = \frac{\$481{,}840}{\$236{,}600/\text{YR.} - \$72{,}660/\text{YR.}}$$

$$= 2.94 \text{ YEARS.}$$

CLEARWATER HEAT PUMP SYSTEM


HEAT SOURCE MEDIA IN
TO DRYLAND POUND
EVAPORATOR
COMPRESSORS
CONDENSER
HEAT SINK MEDIA IN
TO PROCESS OR DOMESTIC WATER HEATING

RESIDENTIAL/COMMERCIAL HEAT PUMP SYSTEM

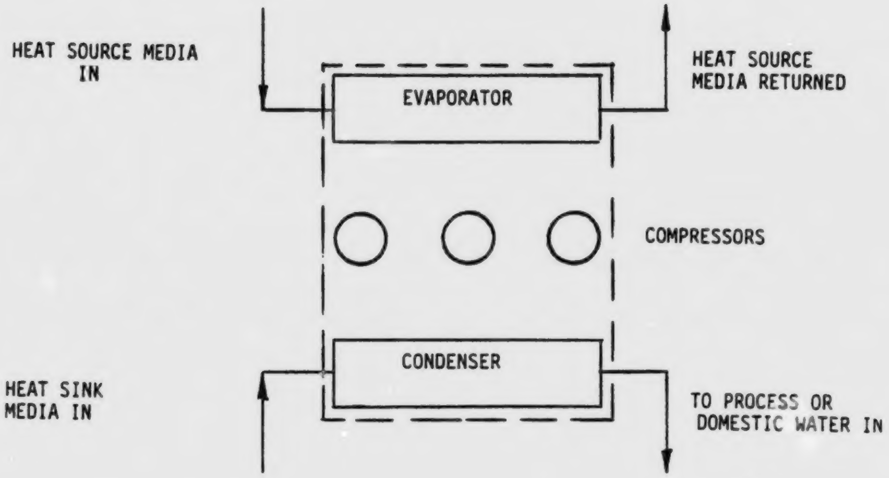

HEAT SOURCE MEDIA IN
HEAT SOURCE MEDIA RETURNED
EVAPORATOR
COMPRESSORS
CONDENSER
HEAT SINK MEDIA IN
TO PROCESS OR DOMESTIC WATER IN

Figure 1.32 - Comparison of Heat Pump Systems

APPENDIX 'A'

Figure A.1; Site Plan

Figure A.2: Facility Layout

Figure A.2; Heat Pump System Flow Diagram

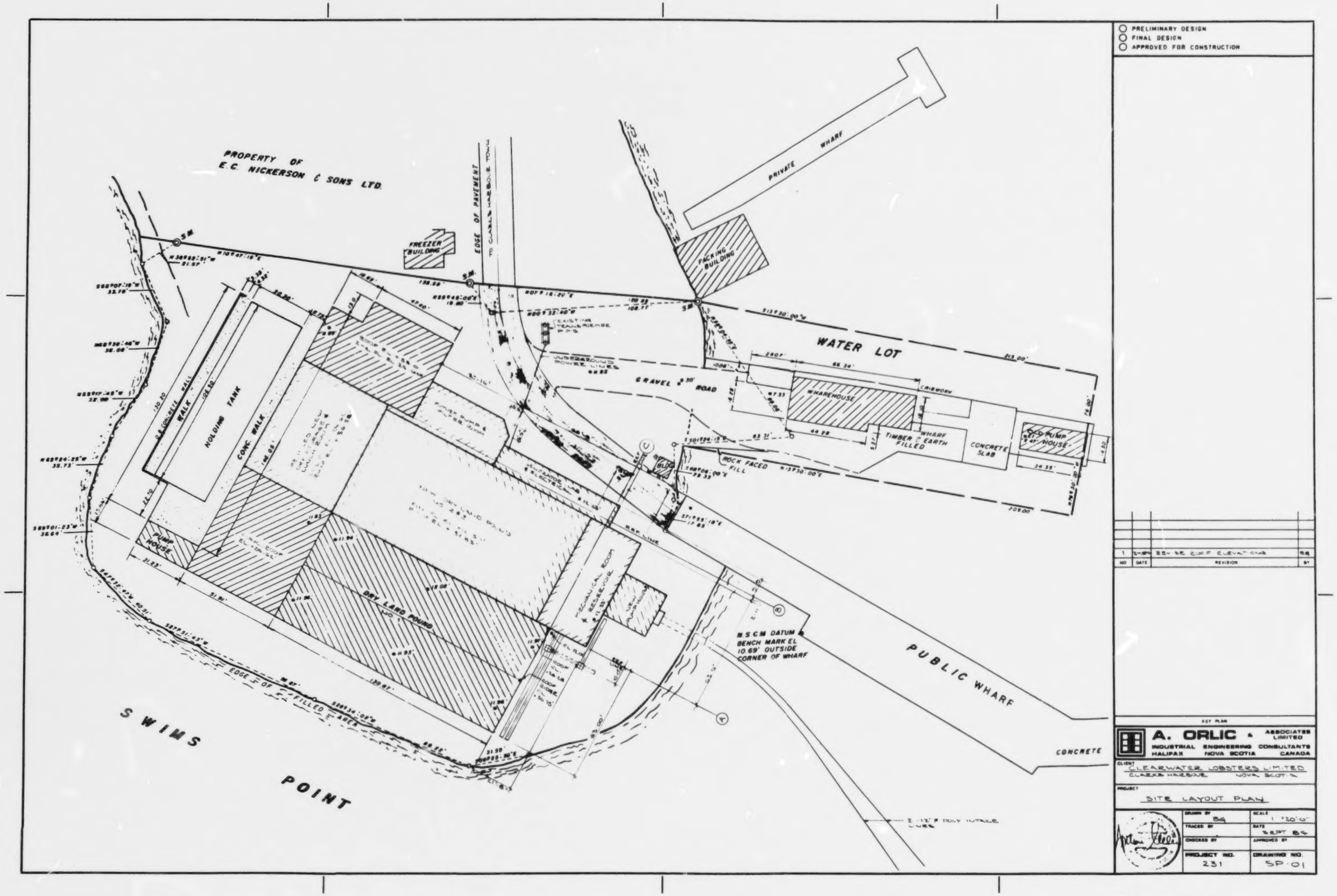

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION
PROPERTY OF E.C. NICKERSON & SONS LTD.
FREEZER BUILDING
EDGE OF PAVEMENT
TO CLARKS HARBOUR TOWN
PRIVATE WHARF
PACKING BUILDING
WATER LOT
S.M.
EXISTING TRANSFORMER
UNDERGROUND POWER LINES
GRAVEL ROAD
WHAREHOUSE
CRIBWORK
TIMBER & EARTH FILLED WHARF
CONCRETE SLAB
PUMP HOUSE
ROCK FACED FILL
BLDG
REF. LINE
WALK
CONC. WALK
HOLDING TANK
FUTURE PUMP & FILTER ROOM
NEW DRY LAND POUND
MECHANICAL ROOM & RESERVOIR
NEW PUMP HOUSE
PUMP HOUSE
DRY LAND POUND NO. 1
N.S.C.M. DATUM BENCH MARK EL 10.69' OUTSIDE CORNER OF WHARF
PUBLIC WHARF
CONCRETE
EDGE OF FILLED AREA
SWIMS POINT
2 - 12" ø POLY INTAKE LINES
NO | DATE | REVISION | BY
KEY PLAN
A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA
CLIENT
CLEARWATER LOBSTERS LIMITED
CLARKS HARBOUR NOVA SCOTIA
PROJECT
SITE LAYOUT PLAN
DRAWN BY BG
SCALE 1" = 20'-0"
TRACED BY
DATE SEPT 84
CHECKED BY
APPROVED BY
PROJECT NO. 231
DRAWING NO. SP-01

Figure A.1

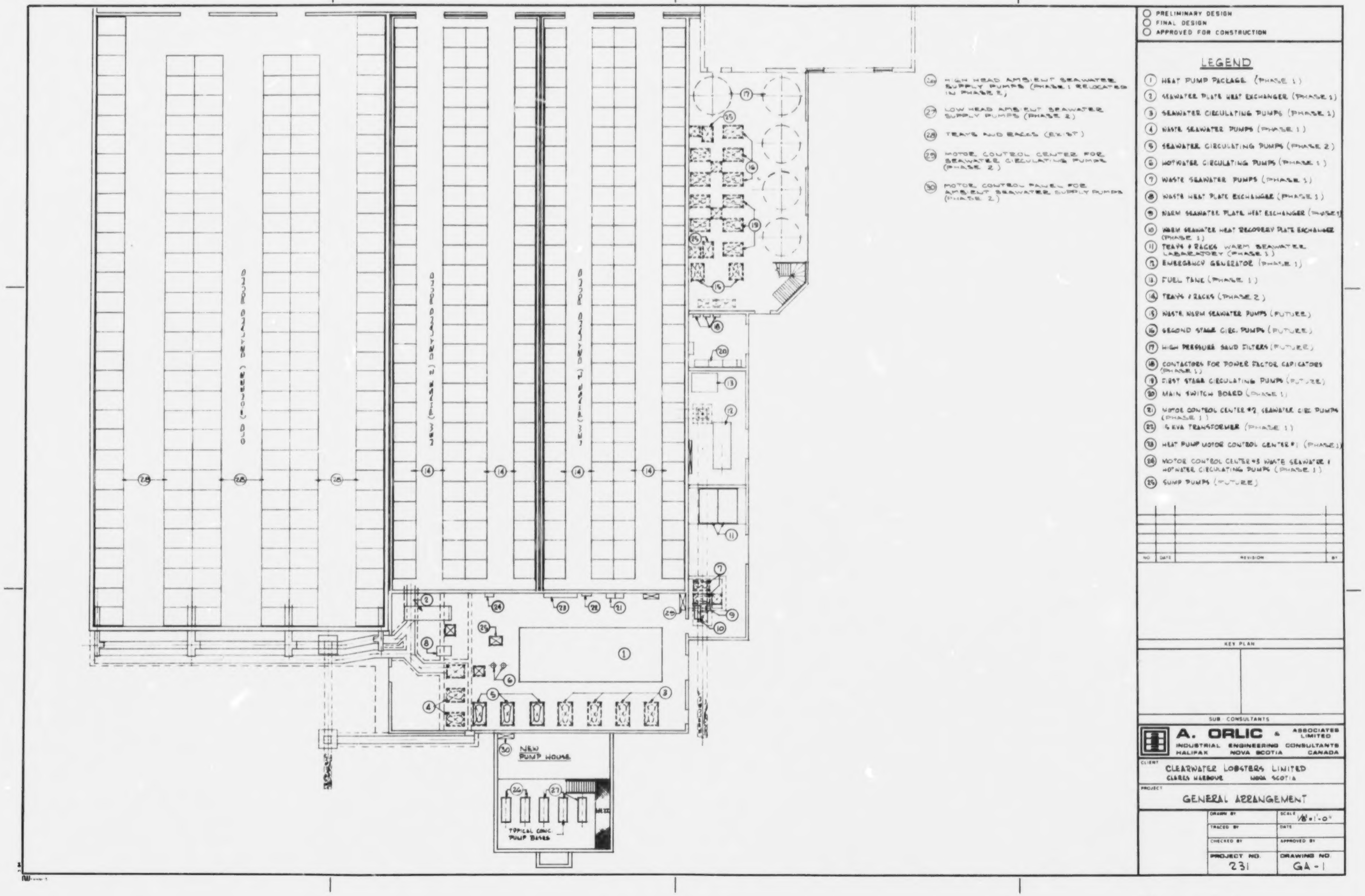

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION
LEGEND
① HEAT PUMP PACKAGE (PHASE 1)
② SEAWATER PLATE HEAT EXCHANGER (PHASE 1)
③ SEAWATER CIRCULATING PUMPS (PHASE 1)
④ WASTE SEAWATER PUMPS (PHASE 1)
⑤ SEAWATER CIRCULATING PUMPS (PHASE 2)
⑥ HOTWATER CIRCULATING PUMPS (PHASE 1)
⑦ WASTE SEAWATER PUMPS (PHASE 1)
⑧ WASTE HEAT PLATE EXCHANGER (PHASE 1)
⑨ WARM SEAWATER PLATE HEAT EXCHANGER (PHASE 1)
⑩ WARM SEAWATER HEAT RECOVERY PLATE EXCHANGER (PHASE 1)
⑪ TRAYS & RACKS WARM SEAWATER LABORATORY (PHASE 1)
⑫ EMERGENCY GENERATOR (PHASE 1)
⑬ FUEL TANK (PHASE 1)
⑭ TRAYS & RACKS (PHASE 2)
⑮ WASTE WARM SEAWATER PUMPS (FUTURE)
⑯ SECOND STAGE CIRC. PUMPS (FUTURE)
⑰ HIGH PRESSURE SAND FILTERS (FUTURE)
⑱ CONTACTORS FOR POWER FACTOR CAPICATORS (PHASE 1)
⑲ FIRST STAGE CIRCULATING PUMPS (FUTURE)
⑳ MAIN SWITCH BOARD (PHASE 1)
㉑ MOTOR CONTROL CENTER #2 SEAWATER CIRC PUMPS (PHASE 1)
㉒ 15 KVA TRANSFORMER (PHASE 1)
㉓ HEAT PUMP MOTOR CONTROL CENTER #1 (PHASE 1)
㉔ MOTOR CONTROL CENTER #3 WASTE SEAWATER & HOTWATER CIRCULATING PUMPS (PHASE 1)
㉕ SUMP PUMPS (FUTURE)
㉖ HIGH HEAD AMBIENT SEAWATER SUPPLY PUMPS (PHASE 1 RELOCATED IN PHASE 2)
㉗ LOW HEAD AMBIENT SEAWATER SUPPLY PUMPS (PHASE 2)
㉘ TRAYS AND RACKS (EXIST)
㉙ MOTOR CONTROL CENTER FOR SEAWATER CIRCULATING PUMPS (PHASE 2)
㉚ MOTOR CONTROL PANEL FOR AMBIENT SEAWATER SUPPLY PUMPS (PHASE 2)
OLD (PIONEER) DRYLAND POUND
NEW (PHASE 2) DRYLAND POUND
NEW (PHASE 2) DRYLAND POUND
NEW PUMP HOUSE
TYPICAL CONIC PUMP BASES
NO
DATE
REVISION
BY
KEY PLAN
SUB CONSULTANTS
A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA
CLIENT
CLEARWATER LOBSTERS LIMITED
CLARKS HARBOUR NOVA SCOTIA
PROJECT
GENERAL ARRANGEMENT
DRAWN BY
SCALE 1/8" = 1'-0"
TRACED BY
DATE
CHECKED BY
APPROVED BY
PROJECT NO. 231
DRAWING NO. GA-1

Figure A.2

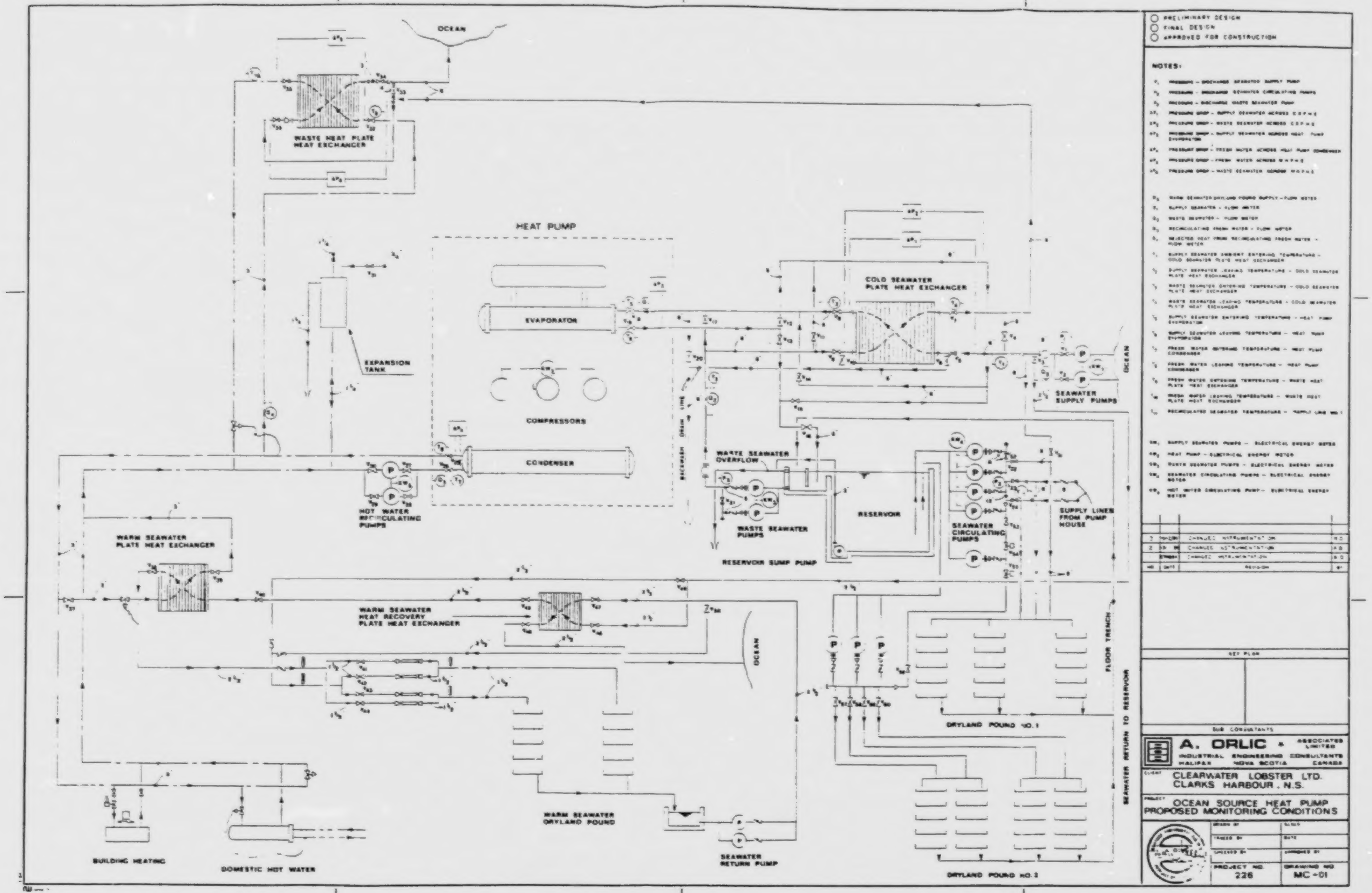
○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION
NOTES:
OCEAN
WASTE HEAT PLATE HEAT EXCHANGER
HEAT PUMP
EVAPORATOR
COMPRESSORS
CONDENSER
EXPANSION TANK
HOT WATER RECIRCULATING PUMPS
COLD SEAWATER PLATE HEAT EXCHANGER
SEAWATER SUPPLY PUMPS
WASTE SEAWATER OVERFLOW
RESERVOIR
WASTE SEAWATER PUMPS
RESERVOIR SUMP PUMP
SEAWATER CIRCULATING PUMPS
SUPPLY LINES FROM PUMP HOUSE
WARM SEAWATER PLATE HEAT EXCHANGER
WARM SEAWATER HEAT RECOVERY PLATE HEAT EXCHANGER
DRYLAND POUND NO.1
DRYLAND POUND NO.2
WARM SEAWATER DRYLAND POUND
SEAWATER RETURN PUMP
BUILDING HEATING
DOMESTIC HOT WATER
FLOOR TRENCH
SEAWATER RETURN TO RESERVOIR
KEY PLAN
SUB CONSULTANTS
A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA
CLIENT
CLEARWATER LOBSTER LTD.
CLARKS HARBOUR, N.S.
PROJECT
OCEAN SOURCE HEAT PUMP
PROPOSED MONITORING CONDITIONS
PROJECT NO.
226
DRAWING NO.
MC-01

Figure A.3

EQUIPMENT LIST AND USED ABBREVIATIONS

1. C.S.W.P.H.E. = Cold Seawater Plate Heat Exchanger
2. H.P. = Heat Pump
3. H.P.E. = Heat Pump Evaporator
4. H.P.C. = Heat Pump Condensor
5. W.H.P.H.E. = Waste Heat Plate Heat Exchanger
6. W.S.W.P.H.E. = Warm Seawater Plate Heat Exchanger
7. W.S.W.H.R.P.H.E. = Waste Seawater Heat Recovery Plate Heat Exchanger
8. C.S.W.D.L.P. = Cold Seawater Dryland Pound
9. W.S.W.D.L.P. = Warm Seawater Dryland Pound
10. C.S.W.R.R. = Cold Seawater Recirculating Resevoir
11. W.S.W.R.R. = Warm Seawater Recirculating Resevoir
12. S.W.S.P. = Seawater Supply Pumps
13. S.W.C.P. = Seawater Circulating Pumps
14. W.S.W.P. = Waste Seawater Pumps
15. H.W.R.P. = Hot Water Recirculating Pumps
16. S.W.R.P. = Seawater Return Pumps

APPENDIX 'B'

Table B-1; Pressures and Differential Pressures

Table B-2; Temperatures

Table B-3; Flow Rates

Table B-4; Electrical Loads

Table B-5; Differential Temperatures

Table B-6; Heat Transfer Rates

Table B-7; Electrical Energy Costs

Table B-8; Performance Rates

Table B-9; Equations Used in Calculations

Table B-10; Constants Used in Calculations

Table B-11; Cost of Thermal Energy Generated by Combustion of No. 2 Fuel Oil

Table B-12; Capital Cost for Heat Pump Installation

Table B-13; Comparison of Boiler Chiller Combination vs. Heat Pump System

TABLE B-1;

PRESSURES AND DIFFERENTIAL PRESSURES

SYMBOL	DESCRIPTION	VALUE	UNITS
P1	Ambient Seawater Supply Pressure	360	kPa
P2	Recirculated Cold Seawater Supply Pressure	195	kPa
P3	Waste Seawater Supply Pressure	270	kPa
DP1	Differential Pressure of Ambient Seawater Stream Across C.S.W.P.H.E.	90	kPa
DP2	Differential Pressure of Waste Seawater Stream Across C.S.W.P.H.E.	90	kPa
DP3	Differential Pressure of Ambient Seawater Stream Across H.P.E.	128	kPa
DP4	Differential Pressure of Recirculated Fresh Water Stream Across H.P.C.	35	kPa
DP5	Differential Pressure of Recirculated Fresh Water Stream Across W.H.P.H.E.	103	kPa
DP6	Differential Pressure of Waste Seawater Stream across W.H.P.H.E.	70	kPa
DP7	Differential Pressure of Recirculated Fresh Water Stream Across W.S.W.P.H.E.	100	kPa
DP8	Differential Pressure of Ambient Seawater Supply to W.S.W.D.L.P. Across W.S.W.P.H.E.	91	kPa
DP9	Differential Pressure of Ambient Seawater Supply to W.S.W.D.L.P. Across W.S.W.H.R.P.H.E.	92	kPa
DP10	Differential Pressure of W.S.W.D.L.P. Waste Seawater Across W.S.W.H.R.P.H.E.	94	kPa

TABLE B-2;

TEMPERATURES

SYMBOL	DESCRIPTION	VALUE	UNITS
T1	Temperature of Ambient Seawater Stream Entering C.S.W.P.H.E. - High	15.5	°C
	- Low	0.5	°C
T2	Temperature of Ambient Seawater Stream Leaving C.S.W.P.H.E.	5.6	°C
T3	Temperature of Waste Seawater Stream Entering C.S.W.P.H.E.	4.15	°C
T4	Temperature of Waste Seawater Stream Leaving C.S.W.P.H.E.	14.9	°C
T5	Temperature of Ambient Seawater Stream Entering H.P.E.	5.6	°C
T6	Temperature of Ambient Seawater Stream Leaving H.P.E.	3.1	°C
T7	Temperature of Recirculated Fresh Water Stream Entering H.P.C.	48.9	°C
T8	Temperature of Recirculated Fresh Water Stream Leaving H.P.C.	60.0	°C
T9	Temperature of Recirculated Fresh Water Stream Entering W.H.P.H.E.	60.0	°C
T10	Temperature of Recirculated Fresh Water Stream Leaving W.H.P.H.E.	48.9	°C
T11	Temperature of Cold Seawatr Stream Leaving C.S.W.R.R. to C.S.W.D.L.P.	4.0	°C
T12	Temperature of Waste Seawater Stream Entering W.H.P.H.E.	14.9	°C
T13	Temperature of Waste Seawater Stream Leaving W.H.P.H.E.	29.6	°C
T14	Temperature of Recirculated Fresh Water Stream Entering W.S.W.P.H.E.	60.0	°C

TABLE B-2;

TEMPERATURES (CONTINUED)

SYMBOL	DESCRIPTION	VALUE	UNITS
T16	Temperature of Ambient Seawater Supply Stream to W.S.W.D.L.P. Entering W.S.W.P.H.E.	5.9	°C
T17	Temperature of Ambient Seawater Supply Stream to W.S.D.L.P. Leaving W.S.W.P.H.E.	23.0	°C
T18	Temperature of Ambient Seawater Stream Supply to W.S.D.L.P. Entering W.S.W.H.R.P.H.E.	0.5	°C
T19	Temperature of Ambient Seawater Stream Supply to W.S.D.L.P. Leaving W.S.W.H.P.P.H.E.	8.4	°C
T20	Temperature of W.S.W.D.L.P. Waste Seawater Stream Entering W.S.W.H.R.P.H.E.	20.0	°C
T21	Temperature of W.S.W.D.L.P. Waste Seawater Stream Leaving W.S.W.H.R.P.H.E.	12.1	°C

TABLE B-3;

FLOW RATES

SYMBOL	DESCRIPTION	VALUE	UNITS
Q1	Ambient Seawater Stream Flow (make-up) Rate Through C.S.W.P.H.E.	37.8	l/s
Q2	Waste Seawater Stream Flow Rate Through C.S.W.P.H.E.	34.7	l/s
Q3	Recirculated Fresh Water Stream Flow Rate Through H.P.C.	12.7	l/s
Q4	Recirculated Fresh Water Stream Flow Rate Through W.H.P.H.E. - Maximum	12.7	l/s
Q5	Ambient Seawater Stream Flow Rate to W.S.W.D.L.P.	6.3	l/s
Q6	Waste Seawater Stream Flow Rate Through W.H.P.H.E. - Maximum	9.6	l/s
Q7	Recirculated Fresh Water Stream Flow Rate Through W.S.W.P.H.E. - Maximum	6.0	l/s
Q8	Ambient Seawater Stream Flow Rate to W.S.W.D.L.P. - Maximum	6.3	l/s
Q9	Ambient Seawater Stream Flow Rate to W.S.W.H.R.P.H.E.	6.3	l/s
Q10	Waste Seawater Stream Flow Rate From W.S.W.D.L.P. Through W.S.W.H.R.P.H.E.	6.3	l/s

TABLE B-4;

ELECTRICAL LOADS

SYMBOL	DESCRIPTION	VALUE	UNITS
KW1	Electrical Load of S.W.S.P.	22.8 (1)	KW
KW2	Electrical Load of H.P.	205.2	KW
KW3	Electrical Load of W.S.W.P.	13.3	KW
KW4	Electrical Load of S.W.C.P.	74.7 (2)	KW
KW5	Electrical Load of H.W.R.P.	5.7	KW

(1) Only one pump operating, supplying:

- 600 U.S.G.P.M. Make-Up Ambient Seawater to the C.S.W.D.L.P. System and
- 100 U.S.G.P.M. to the W.S.W.D.L.P. System (laboratory)

(2) Three pumps operating, supplying (recirculating) 4,000 U.S.G.P.M. of Cold Seawater to C.S.W.D.L.P. System.

TABLE B-5;

DIFFERENTIAL TEMPERATURES

SYMBOL	DESCRIPTION	VALUE	UNITS
DT1	Differential Temperature of Ambient Seawater Across C.W.P.H.E.; or DT1 = T1 - T2 - Maximum	9.9	°C
DT2	Differential Pressure of Waste Seawater Stream Across C.S.W.P.H.E.; or DT2 = T4 - T3 - Maximum	10.75	°C
DT3	Differential Temperature of Ambient Seawater Stream Across H.P.E.; or DT3 = T5 - T6 - Maximum	2.5	°C
DT4	Differential Temperature of Recirculated Fresh Water Stream Across H.P.C.; or DT4 = T8 - T7 - Maximum	11.1	°C
DT5	Differential Temperature of Recirculated Fresh Water Stream Across W.H.P.H.E.; or DT5 = T9 - T10 - Maximum	11.1	°C
DT6	Differential Temperature of Waste Seawater Stream Across W.H.P.H.E.; or DT6 = T13 - T12 - Maximum	14.7	°C
DT7	Differential Temperature of Recirculated Cold Seawater Across C.S.W.D.L.P.; or DT7 = T3 - T11 - Maximum	0.15	°C
DT8	Differential Temperature of Recirculated Fresh Water Stream Across W.S.W.P.H.E.; or DT8 = T14 - T15 - Maximum	18.0	°C
DT9	Differential Temperature of Ambient Seawater Supply to W.S.W.D.L.P. Across W.S.W.P.H.E.; or DT9 = T17 - T16 - Maximum	17.1	°C

TABLE B-5;

DIFFERENTIAL TEMPERATURES (CONTINUED)

SYMBOL	DESCRIPTION	VALUE	UNITS
DT10	Differential Temperature of Ambient Seawater Supply to W.S.W.D.L.P. Across W.S.W.H.R.P.H.E.; or DT10 = T19 - T18	7.9	°C
DT11	Differential Temperature of W.S.W.D.L.P. Waste Seawater Stream Across W.S.W.H.E.; or DT11 = T20 - T21 - Maximum	7.9	°C
DT12	Approach Temperature Differential of Cold and Hot Seawater Streams at C.S.W.P.H.E.	1.45	°C

TABLE B-6;

HEAT TRANSFER RATES

SYMBOL	DESCRIPTION	VALUE	UNITS
HT1	Heat Energy Rate Rejected by Ambient Seawater Stream through S.S.W.P.H.E.; - Maximum	1,526	KW
HT2	Heat Energy Rate Absorbed by Waste Seawater Stream through C.S.W.P.H.E.; - Maximum	1,526	KW
HT3	Heat Energy Rate Rejected by Ambient Seawater Stream through H.P.E.; - Maximum	385	KW
HT4	Heat Energy Rate Absorbed by Recirculated Fresh Water Stream through H.P.C.; - Maximum	590	KW
HT5	Heat Energy Rate Rejected by Recirculated Fresh Water Stream through W.H.P.H.E. - Maximum	590	KW
HT6	Heat Energy Rate absorbed by Waste Seawater Stream through W.H.P.H.E. - Maximum	590	KW
HT7	Heat Energy Rate Rejected by Recirculated Fresh Water Stream through W.S.W.P.H.E. - Maximum	452	KW
HT8	Heat Energy Absorbed by Ambient Seawater Supply to W.S.W.D.L.P. through W.S.W.P.H.E. - Maximum	452	KW
HT9	Heat Energy Absorbed by Ambient Seawater Supply Stream to W.S.W.H.R.P.H.E. - Maximum	203	KW
HT10	Heat Energy Rate Absorbed by Recirculated Cold Seawater through C.S.W.D.L.P. - Maximum	203	KW
HT11	Heat Energy Rate Absorbed by Recirculated Cold Seawater Through C.S.W.D.L.P. - Maximum	161.9	KW
HT12	Approach Thermal Energy at C.S.W.P.H.E.	223.6	KW

TABLE B-7;

ELECTRICAL ENERGY COSTS (1)

SYMBOL	DESCRIPTION	VALUE	UNITS
EC1	Daily Electrical Energy Costs for Operating S.W.S.P.	28.34	$/D
EC2	Daily Electrical Energy Costs for Operating H.P.	255.04	$/D
EC3	Daily Electrical Energy Costs for Operating W.S.W.P.	16.54	$/D
EC4	Daily Electrical Energy Costs for Operating S.W.C.P.	104.48	$/D
EC5	Daily Electrical Energy Costs for Operating H.W.R.P.	7.09	$/D
TEC	Daily Total Electrical Energy Costs	411.49	$/D
HPED	Average Cost of Heat Energy Generated by H.P.	0.0184	$/KWH

(1) Based on 24 hours per day continuous operation and the average electrical energy costs (Demand Charges + energy usage) of $0.0518/KWH.

TABLE B-8;

PERFORMANCE RATES

SYMBOL	DESCRIPTION	VALUE	UNITS
PHU	Percent of Heat Utilization Generated by H.P. - Maximum	78.1	%
COP	Coefficient of Performance of H.P. - Maximum	2.882	---
LMTD	Logarithmic Mean Temperature Difference of C.S.W.P.H.E.	0.96	°C
U	Coefficient of Heat Transfer Rate of C.S.W.P.H.E. - Maximum	4.59	$\frac{KW}{m^2\ °C}$

TABLE B-9;

EQUATIONS USED IN CALCULATIONS

SYMBOL	DESCRIPTION	UNITS
HT1	Q1 X C1 X DT1	KW
HT2	Q2 X C1 X DT2	KW
HT3	Q1 X C1 X DT3	KW
HT4	Q3 X C2 X DT4	KW
HT5	Q4 X C2 X DT5	KW
HT6	Q6 X C1 X DT6	KW
HT7	Q7 X C2 X DT8	KW
HT8	Q8 X C1 X DT9	KW
HT9	Q9 X C1 X DT10	KW
HT10	Q10 X C1 X DT11	KW
HT11	Q11 X C1 X DT7	KW
HT12	Q1 X C1 X DT12	KW
EC1	KW1 X C3 X C4	$/D
EC2	KW2 X C3 X C4	$/D
EC3	KW3 X C3 X C4	$/D
EC4	KW4 X C3 X C4	$/D
EC5	KW5 X C3 X C4	$/D
TEC	EC1 + EC2 + EC3 + EC4 + EC5	$/D
HPEC	EC2 / (HT4 X C3)	$/KWH
PHU	[(HT4 - HT5)/HT4] X 100	%
COP	HT4/KW2	--
LMTD	[(T1 - T4) - (T2 - T3)]/lN[(T1 - T4)/(T2 - T3]	C
U	HT1/(C5 X LMTD)	$\frac{KW}{m^2 \, ^{\circ}C}$

TABLE B-10;

CONSTANTS USED IN CALCULATIONS

SYMBOL	DESCRIPTION	VALUE	UNITS
C1	Specific Heat of Seawater	4.079	$\frac{KW.sec}{1°C}$
C2	Specific Heat of Fresh Water	4.187	$\frac{KW.sec}{1°C}$
C3	Daily Operating Period	24	HOURS/D
C4	Average Electrical Energy Cost	0.0518	$/KWH
C5	Net Heat Transfer Area of C.S.W.P.H.E.	356.1	m^2
C6	Specific Gravity of Seawater	1.03	----
C7	Specific Gravity of Fresh Water	1	----
C8	Net Heat Transfer Area of W.H.P.H.E.	3.0	M^2
C9	Net Heat Transfer Area of W.S.W.P.H.E.	2.04	M^2
C10	Net Heat Transfer area of W.S.W.H.R.P.H.E.	6.5	M^2
C11	Efficiency of S.W.S.P.	0.77	----
C12	Efficiency of W.S.W.P.	0.77	----
C13	Efficiency of S.W.C.P.	0.75	----
C14	Efficiency of H.W.R.P.	0.59	----
C15	Average Efficiency of Electrical Drives	0.90	----

TABLE B-11;

COST OF THERMAL ENERGY GENERATED BY COMBUSTION OF NO. 2 FUEL OIL

1. STEAM GENERATING UNIT; 30 HP L.P. FIRE TUBE STEAM BOILER

   a) **MANUFACTURES RATINGS**

   - Maximum thermal energy output = 294.1 KW
   - Maximum No. 2 fuel oil energy input = 34.88 l/H
   - Maximum electrical energy input = 1.2 KW

   b) **ENERGY COST RATES**

	PROJECTED	ACTUAL
- No. 2 fuel oil	= $0.315/l	$0.395/l
- Electrical energy	= $0.0518/KWH	$0.0467/KWH

   c) **ENERGIES INPUT COSTS**

	PROJECTED	ACTUAL
- No. 2 fuel oil	= $10.986/H	$13.778/H
- Electrical energy	= $0.062/H	$0.056/H
	= $11.048/H	$13.834/H

   d) **MINIMUM COST OF THERMAL ENERGY OUTPUT**

   i) $\frac{\$11.048/H}{294.1\ KW}$ = $0.0376/KWH (PROJECTED)

   ii) $\frac{\$13.834/h}{294.1\ KW}$ = $0.047/KWH (ACTUAL)

TABLE B.12

CAPITAL COST FOR HEAT PUMP INSTALLATION

QUANTITY	DESCRIPTION	COST
2	SEAWATER PUMPS	$ 12,390
2	WASTE SEAWATER PUMPS	11,300
2	HOT WATER RECIRCULATING PUMPS	6,100
1	HEAT PUMP PACKAGE	200,000
1	TITANIUM COLD SEAWATER PLATE HEAT EXCHANGER	100,000
-	BUILDINGS AND RESERVOIR (50% OF TOTAL BUILDING COSTS)	81,650
-	PIPING (30% OF TOTAL PIPING)	10,140
-	ELECTRICAL (30% TO TOTAL ELECTRICAL)	27,000
-	LABOR (30% OF TOTAL LABOUR)	3,000
-	CONTINGENCIES (30% OF TOTAL CONTINGENCIES)	10,260
-	ENGINEERING (40% OF TOTAL ENGINEERING)	20,000
	TOTAL PACKAGE INSTALLED	$481,840

TABLE B.13

COMPARISON OF BOILER & CHILLER COMBINATION VS. HEAT PUMP SYSTEM

THIS COMPARISON WILL BE BASED UPON GENERATING 345.5 KW OF "COOLING" AND 416.6 KW OF HEATING.

A) BOILER & CHILLER COMBINATION

i) FOR A BOILER TO GENERATE 416.6 KW OF HEATING FOR THE 26 CALENDAR WEEKS IT WILL COST:

416.6 KW X 16 HR/DAY X 7 DAY/WK X 26 WK X $0.047 (1) /KWH

= $57,017.54

ii) FOR A CHILLER TO GENERATE 345.5 KW OF COOLING FOR THE 26 CALENDAR WEEKS (BASED ON AN AVERAGE EER OF 1.15) IT WILL COST:

345.5/1.15 KW X 24 HR/DAY 7 DAY/WEEK X 26 WEEK X $0.0467 (2) /KWH

= $61,284.37

THEREFORE, TOTAL COST FOR 6 MONTHS IS $118,300.00

TOTAL ANNUAL COSTS $236,600.00

B) HEAT PUMP SYSTEM

THE ELECTRICAL INPUT OF THE HEAT PUMP SYSTEM TO GENERATE 416.6 KW OF HEATING AND 345.5 KW OF COOLING WAS 178.1 KW. FOR 26 CALENDAR WEEKS THIS WOULD COST:

178.1 KW X 24 HR/DAY X 7 DAYS/WK X 26 WK X $0.0467/KWH = $36,329.84

TOTAL ANNUAL COST IS: $36,330 X 2 = $72,660.00

(1) REFER TO TABLE B-11
(2) REFER TO TABLE I-4

APPENDIX 'C' - EQUIPMENT PERFORMANCE SPECIFICATIONS

C.1 - Heat Pump

C.2 - Cold Seawater Plate Heat Exchanger

C.3 - Waste Plate Heat Exchanger

C.4 - Warm Seawater Plate Heat Exchanger

C.5 - Warm Seawater Heat Recovery Plate Heat Exchanger

C.6 - Seawater Supply Pumps

C.7 - Seawater Supply Pumps

C.8 - Waste Seawater Pumps

C.9 - Hot Water Circulating Pumps

C.10 - Seawater Return Pumps

C.1 - Heat Pump

J. H. LOCK & SONS LIMITED

QUOTATION/CONTRACT
CLEARWATER LOBSTER LTD.

Lobster Cooling System
With Heat Recovery

Reference: #7793-1

REFRIGERATION • AIR CONDITIONING • HEAT EXCHANGERS • STEEL FABRICATION

J. H. LOCK & SONS LIMITED

HEAD OFFICE: 190 PERTH AVENUE, TORONTO, ONTARIO M6P 3X4
TELEPHONE 416-531-1186, TELEX: 06-218525
DISTRICT OFFICES: DARTMOUTH — MONTREAL — TORONTO — CALGARY
IN B.C. — CORY LOCK LIMITED, VANCOUVER

Reply to: J.H. LOCK & SONS LTD, 19 Acadia Street, Dartmouth, Nova Scotia, B2Y 2N1 Telephone: (902)469-6642 Tlx: 019-21704

Quotation/Contract

PURCHASER: CLEARWATER LOBSTER LTD.

DATE OF QUOTATION: December 7, 1983

ADDRESS: 743 Bedford Highway
Halifax, Nova Scotia

REFERENCE: #7793-1

PROJECT: LOBSTER COOLING SYSTEM WITH HEAT RECOVERY

SITE LOCATION: Clearwater Lobster, Clarks Harbour, Nova Scotia

CONSULTING ENGINEERS: A. Orlic & Associates Ltd.

REGISTERED OWNER OF REAL PROPERTY:

DESCRIPTION OF REAL PROPERTY:

J. H. LOCK & SONS, LIMITED

DATE December 7, 1983

QUOTATION TO: CLEARWATER LOBSTER LTD.

We are pleased to quote on your requirements as detailed in the following quotation. This quotation, if accepted by you in writing where indicated and approved by our authorized officer in writing, will become our contract.

CONTENTS

PAGE NO.	TOPIC
1	Title and Identification Page
2	Table of Contents
3 & 4	Terms and Conditions
5 - 9	Details of Quote
10	Contract Price & Signature Page

Other documents forming part of this Quotation/Contract:

5. TERMS OF PAYMENT

(a) Unless otherwise specified in this Quotation/Contract, payment shall be made by the Purchaser to the Vendor in respect of the Contract Price as follows:

(i) Goods sold without installation: 25% upon acceptance of this quotation by the Purchaser; an amount representing the value of each shipment, payable upon delivery; and the unpaid balance upon final shipment.

(ii) Goods sold with installation: 25% upon acceptance of this quotation by the Purchaser; an additional 25% upon written notification by the Vendor to the Purchaser that the goods are ready for shipment; an additional 35% immediately after installation but prior to the commencement of operation of the goods or related systems; and a final payment of 15% upon completion.

(b) Timely payments according to the terms of this Quotation/Contract is of the essence of the contract.

6. WARRANTY — UNLESS OTHERWISE SPECIFIED IN THIS QUOTATION/CONTRACT, THE VENDOR AGREES TO WARRANT THE GOODS AND INSTALLATION SOLD HEREUNDER AGAINST ORIGINAL DEFECTS IN MANUFACTURE AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM COMPLETION AS DEFINED IN SECTION 9 OF THESE TERMS AND CONDITIONS. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, STATUTORY OR OTHERWISE, EXPRESS OR IMPLIED, OF EITHER MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE TERMS OF THE VENDOR'S WARRANTY ARE AS FOLLOWS:

(a) In respect of goods sold without installation, the Vendor's sole liability shall be to repair or replace, at the Vendor's option, F.O.B. point of manufacture, any defective goods or parts thereof.

(b) In respect of goods sold with installation, the Vendor's sole liability shall be to repair or replace, at the Vendor's option, any defective goods or parts thereof or any defective workmanship. The Vendor shall be responsible for all of its costs in connection therewith other than the out-of-pocket expenses incurred by the Vendor's employees and agents travelling from the Vendor's nearest place of business to the jobsite and charges for labour performed after normal working hours at the request of the Purchaser, which latter expenses and charges shall be for the account of the Purchaser.

(c) The Vendor warrants goods not of the Vendor's manufacture only to the extent to which the Vendor is able to enforce a claim for liability against the manufacturer thereof.

(d) The Purchaser shall promptly give written notice to the Vendor after discovery of an apparent defect.

(e) As a condition precedent to any liability by the Vendor hereunder, the Purchaser shall use, operate and maintain the goods and related systems in a careful, prudent, and reasonable manner, and in conformity with the Vendor's and/or the manufacturers' instructions.

(f) THE FOREGOING CONSTITUTES THE VENDOR'S SOLE LIABILITY ARISING OUT OF THE DESIGN, MANUFACTURE, SALE, INSTALLATION, OR USE OF THE GOODS.

(g) This warranty shall be void if the Purchaser is in default under the terms of payment of this contract.

7. The Vendor shall not be liable for damages, whether direct, indirect, special or consequential, arising out of the goods, or the installation, operation, or failure of operation of the goods or related systems.

8. CHANGE IN SCOPE OF WORK — If the Purchaser requests a change in the scope of the work under this Quotation/Contract, the Vendor will submit a Contract revision to the Purchaser which shall set forth the proposed changes in the work, and if the proposed changes result in an addition to or deduction from the Contract Price, the Contract Revision shall set forth the amount of such addition or deduction. Contract Revision shall not be binding or enforceable unless accepted in writing by the Purchaser and approved in writing by a deputy authorized officer of the Vendor. Upon such acceptance and approval, the Contract Revision shall become part of the contract and, except when inconsistent therewith, shall be subject to all its provisions.

9. COMPLETION AND ACCEPTANCE OF WORK

(a) In respect of goods sold without installation, "Completion" shall be deemed to occur when the Purchaser assumes liability for the goods in accordance with section 4 of these Terms and Conditions.

(b) In respect of goods sold with installation, and unless otherwise defined in this Quotation/Contract, "Completion" shall be deemed to occur when any one of the following events takes place:

(i) The Purchaser signs an acceptance certificate;

(ii) The Vendor has installed and, where applicable, successfully tested the installation;

(iii) The Purchaser commences regular use of the goods or related systems; or

(iv) An independent expert, mutually acceptable to the Purchaser and the Vendor certifies that the work has been completed.

(c) Nothing in subsections (a) or (b) shall relieve the Vendor from its obligation to correct deficiencies in the work under this contract, or to honour the warranty provisions contained herein.

(d) The occurrence of any one of the events described in section 9(b)(i), (iii) and (iv) shall constitute acceptance of the work.

10. BONDS Performance bonds and material and labour payment bonds will be provided by the Vendor upon request. Unless the Contract Price expressly includes the cost of such bonds, the Purchaser, in addition to the Contract Price, shall pay the cost of such bonds to the Vendor at the time of the receipt thereof by the Purchaser.

NO AGREEMENT OR UNDERSTANDING ENTERED INTO PRIOR TO THE DATE OF THE CONTRACT SHALL IN ANY WAY VARY OR MODIFY THE PROVISIONS OF THIS CONTRACT. NO AGREEMENT OR UNDERSTANDING ENTERED INTO UBSEQUENT TO THE DATE OF THE CONTRACT WHICH VARIES OR MODIFIES THE PROVISIONS OF THIS CONTRACT HALL BE BINDING ON THE VENDOR UNLESS CONVEYED IN WRITING AND EXECUTED BY A DULY AUTHORIZED. OFFICER OF THE VENDOR.

J. H. LOCK & SONS, LIMITED **DATE** December 7, 1983

PURCHASER

TERMS AND CONDITIONS

SUBJECT TO WRITTEN APPROVAL BY A DULY AUTHORIZED OFFICER OF J. H. LOCK & SONS, LIMITED (THE "VENDOR"), THIS QUOTATION, IF ACCEPTED IN WRITING BY THE PURCHASER, SHALL CONSTITUTE A BINDING CONDITIONAL CONTRACT OF SALE AS OF THE DATE OF THE PURCHASER'S ACCEPTANCE OR AS OF THE DATE OF THE VENDOR'S APPROVAL, WHICHEVER IS LATER. THIS QUOTATION IS INVALID IF NOT ACCEPTED BY THE PURCHASER WITHIN SIXTY DAYS OF THE DATE OF QUOTATION.

1. TITLE

The title and ownership to and in the goods sold hereunder (the "goods") shall remain in the Vendor until payment in full of the Contract Price and any additional amounts payable to the Vendor pursuant to sections 2 and 10 of these Terms and Conditions. The Vendor hereby reserves a security interest in and to the goods, and the proceeds thereof, to secure the said payment and all of the other obligations of the Purchaser. At the option of the Vendor, the Purchaser will join with the Vendor in executing, in a form satisfactory to the Vendor, one or more financing statements or similar instruments pursuant to any applicable personal property security legislation. The Purchaser hereby authorizes the Vendor to file one or more such statements or instruments signed by the Vendor alone as the secured party. If the goods are or are to become affixed to real property, the Purchaser represents that a true and correct description of such real property and that the name of the registered owner thereof are as indicated on Page 1 of this Quotation/Contract.

(b) In the event of default by the Purchaser under the terms of payment of this contract, the full amount of the Contract Price, less any payments previously made, shall become due and payable, and the Vendor or his agent shall have the right to enter upon the premises and remove the materials and equipment hereunder, and to dispose of them as the Vendor may determine. If the proceeds from such disposal, less any related expenses, including but not limited to costs of seizure, removal and sale, and legal costs connected therewith, (the "net proceeds") are not sufficient to cover the amount in default, the Purchaser shall be liable to the Vendor for such deficiency. If the net proceeds exceed the amount in default such excess shall be returned to the Purchaser, and the Vendor shall not be liable further whether in respect of completion, performance, warranty or other contract terms.

(c) The Purchaser hereby waives all rights and claims against the Vendor in the event that the circumstances provided for in section 1(b) arise, except for the express right of recovery of excess net proceeds as provided in that section.

(d) The Purchaser hereby waives the provisions of any Conditional Sales Act or other applicable legislation which limits the Vendor's rights to seize the security provided for herein, and to sue for any deficiency. The Purchaser expressly confers upon the Vendor the rights to seize and sell the material and equipement and to recover from the Purchaser, by action on the covenant, the principal, interest and other moneys from time to time owing under this contract.

2. PRICE ADJUSTMENTS

Unless otherwise expressly provided in the contract/quotation:

(a) The Purchaser shall pay all taxes, duties, levies and other charges assessed against or in respect of the goods.

(b) If any taxes, duties, levies, or other charges shown to be included in the Contract Price are increased subsequent to the Date of Quotation, and increase the Vendor's costs hereunder, such increase shall be paid by the Purchaser to the Vendor.

(c) The Contract Price quoted herein is based on prices, costs and conditions prevailing at the Date of Quotation. Unless otherwise specified, if the estimated delivery and/or installation date is more than six months from the date of the contract, and if prior to shipment or installation there is an increase in the Purchaser's costs due to increases in labour rates, cost of materials, suppliers' prices, foreign exchange, storage charges, or freight rates, such increase shall be paid to the Vendor by the Purchaser.

(d) If delivery or installation is delayed by the Purchaser, or by anyone under the Purchaser's control, for more than two months after the time estimated, any increase in those categories of the Vendor's costs listed in section 2(c) shall be paid to the Vendor by the Purchaser.

(e) All payments by the Purchaser to the Vendor under section 2 shall be in addition to the Contract Price and shall be paid at the time of the final payment under the contract.

3. DELIVERY AND INSTALLATION — Delivery and installation times and dates are approximate and are subject to extension for delays caused by fire, strike, lockout, labour and dispute, civil or military authority, riot, embargo, car shortage, wrecks or delays in transportation Acts of God, late delivery or non-delivery by the Vendor's suppliers, changes in the scope of the work as provided in section 8 of these Terms and Conditions, or other causes beyond the reasonable control of the Vendor, and the Vendor shall not be liable for any losses or damages resulting from any such causes. Acceptance of the work shall be a waiver by the Purchaser of all claims for damages for delay from any cause whatsoever.

4. RESPONSIBILITY AND INSURANCE

(a) In respect of goods sold F.O.B. point of origin, the Vendor shall deliver the goods in good condition to a common carrier or the Purchaser at the Vendor's shipping point, and thereafter all risks of loss or damage thereto shall be assumed by the Purchaser.

(b) In respect of goods sold F.O.B. job site or sold with installation, the Purchaser shall assume liability for all risks of loss or damage upon delivery of the goods at the job site or at the Purchaser's designated delivery point.

(c) The Purchaser shall insure the goods against loss or damage from fire, theft, malicious damage or other causes as and from the time the Purchaser becomes responsible for the goods pursuant to sections 4(a) and 4(b) of these Terms and Conditions. The face value of the insurance policy shall be made payable to the Vendor as its interests may appear until the Contract Price shall be paid in full.

(d) Upon the request of the Vendor, the Purchaser shall provide an insurance certificate as evidence of the compliance with section 4(c) of these Terms and Conditions.

(continued)

J. H. LOCK & SONS, LIMITED DATE December 7, 1983

QUOTATION TO: CLEARWATER LOBSTER LTD.
743 Bedford Highway
Halifax, Nova Scotia

Attention: John Risley

Re: Proposal 7793-1

Dear Sir:

In accordance with requested modifications, we take pleasure in submitting our revised proposal for your consideration.

We intend to supply a Packaged Refrigeration System whose overall dimensions would be approximately 30 ft. long x 14 ft. wide x 10 ft. high. This unit would be fabricated in our Dartmouth Shop so that it could be shipped in two - 30 ft. long x 7 ft. wide portions. Our mechanics would mate the two halves on site, provide start-up service and train your operators. The system would consist of the following major equipment:

COMPRESSORS

Two - MYCOM Model F6B 6 cylinder Reciprocating Compressor for R12 Refrigerant.

Capacity:	43.8 TR Each
Power:	95.7 BHP
Speed:	972 RPM
Evaporating Temperature:	+29° F
Condensing Temperature:	143° F
Discharge Temperature:	177° F
Motor Size:	100 HP

. . ./6

J. H. LOCK & SONS, LIMITED DATE December 7, 1983

QUOTATION TO: CLEARWATER LOBSTER LTD.

One - MYCOM Model F4B 4 cylinder Reciprocating Compressor for R12 Refrigerant.

Capacity: 31.2 TR
Power: 72.4 BHP
Speed: 1069 RPM
Evaporating Temperature: +29° F
Condensing Temperature: 143° F
Discharge Temperature: 183° F
Motor Size: 75 HP

Total capacity at above conditions: 118.8 TR

Each of the above Compressors would be supplied complete with the following:

- Suction and discharge stop valves
- Suction and discharge thermometers
- Refrigerant cooled oil cooler
- Low pressure, high pressure, oil pressure and oil temperature switches
- Crankcase heater
- Oil separator with automatic return kit
- Compressor flywheel, motor pulley and V-belts
- Belt guard
- TEFC 3/60/575V/1800 RPM/ 1.15 S.F. High Efficiency Motor

CHILLER

One - 16" Dia. x 24' Long 3 Pass Flooded Seawater Chiller c/w 16" Dia. x 20' Long Surge Drum.

Shellside: R12
E.T. 29.5° F
DWP 200 PSIG

Tubeside: Seawater
Inlet: 42.1° F (5.6 °C
Outlet: 37.6° F (3.1 °C
Flow: 600 USGPM
Pressure Drop: 18.6 PSI (128.25 kPa)
DWP 100 PSIG

. . ./7

QUOTATION TO: CLEARWATER LOBSTER LTD.

Total Heat Exchange: 112.8 TR

Construction: Titanium tubes
Titanium clad carbon steel tubesheet
Epoxy coated carbon steel heads
Carbon steel shell

The Chiller would be supplied complete with the following:

- Temperature compensated back pressure regulator for seawater temperature control
- Operating level controller and high level cutout
- Freeze protection thermostat
- Oil recovery vessel with return to crankcase system

CONDENSER

One - 12" Dia. x 22' Long 2 Pass Shell and Tube Freshwater Condenser.

Shellside: R12
Inlet: 143° F Sat.Temp./179° F Actual ([illegible])
~~Outlet: 140° F~~
~~Flow: 200 USGPM~~ 70°C
~~Pressure Drop: 5 PSI~~
~~DWP: 100 PSIG~~

Tubeside: Freshwater
Inlet: 120° F (49°C)
Outlet: 140° F (60°C)
Flow: 200 USGPM (12.6 l/s)
Pressure Drop: 5 PSI
DWP: 100 PSIG

Total Heat Exchange: 1,978,000 BTU/Hr.

Construction: Cupro-Nickel Tubes
Carbon Steel Shell, Heads & Tubesheet

The Condenser would be supplied complete with a Temperature Compensated Outlet Pressure Regulator for Water Temperature Control.

. . ./8

HIGH PRESSURE RECEIVER

One - 16" Dia. x 22' Long Horizontal H.P. Receiver.

Holding Capacity: 1,770 lb. at 80% full.

This Unit would be able to hold the entire Refrigerant Charge of the System.

MOTOR CONTROL CENTRE

One - ALLEN BRADLEY M.C.C. complete with the following:

2 - 100 HP Auto-Transformer Starters
1 - 75 HP Auto-Transformer Starters
1 - 5 KVA 575V/110V Control Transformer

Each of the above would be supplied with a fused disconnect and bus bar material would be copper.

Overall Dimension: 80" Wide x 92" High x 15" Deep

CONTROL PANEL

One - Package Mounted Prewired Electrical Control Panel complete with Micro-Processor, Ammeter Relays, Running Time Meters, Selector Switches and Pilot Lights.

The Processor would be programmed prior to installation.

All control wiring from panel to control devices on the package would be installed in our shop.

. . ./9

VALVES, CONTROLS AND OTHER EQUIPMENT

We would supply all necessary Pipe, Valves, Fittings and Controls to interconnect the above equipment, all as per the Refrigeration Code CSA B52 and Nova Scotia Department of Labour Regulations.

The Chiller and Suction Piping would be insulated with foam-in-place urethane insulation and finished with a gel coat.

This Unit would be piped generally as per enclosed sketch with all equipment mounted on a rigid structural steel base. The unit would be finished with one coat of primer and one coat of enamel paint.

We have also included two complete synthetic oil charges and one complete refrigerant charge.

In addition we will supply 4 copies of an Operation and Maintenance Manual.

SITE LABOUR

We will install the above Packaged Refrigeration System in Clarks Harbour and run necessary relief valve and fire valve lines to the outdoors.

We will also provide a mechanic for 15 days to start up the system and train your operating staff.

MATERIALS AND SERVICES BY OTHERS

1. Provision of clear access for installation of this Packaged Refrigeration System.
2. All field power and control wiring.
3. All field seawater and fresh water piping.
4. Foundation and grouting for package.
5. Cutting and patching through walls, floors and ceilings.
6. Any other equipment or service not mentioned in the above proposal.

. . . /10

J. H. LOCK & SONS, LIMITED DATE December 7, 1983

QUOTATION TO: CLEARWATER LOBSTER LTD.

CONTRACT PRICE: $198,674.00
FOB Clarks Harbour, N.S.

TAXES: Federal — Extra, if applicable
Provincial — Extra, if applicable
Other —

DUTIES AND OTHER CHARGES:

TERMS OF PAYMENT: As per Page 4, Section 5

Purchaser hereby agrees to pay interest at the rate of ...24.. percent per annum on sums overdue according to the terms of payment.

SHIPPING WEIGHT:

ESTIMATED DELIVERY AND/OR INSTALLATION DATE:
Subject to the provisions of Section 3 of the Terms and Conditions, the Vendor estimates that the goods will be ready for shipment approximately ..16.. weeks from the date of the Vendor's approval, subject to receipt of full information and/or approved drawings, if applicable, and that installation, if included, will be finished approximately ...2... weeks from delivery of the goods.

GUARANTOR(S) required ☐ not required ☐. This Quotation/Contract submitted by:

Signature ....
Daniel Moscovitch, P.Eng.
........Maritime District Engineer...
Name and Position

PURCHASER'S ACCEPTANCE

The Purchaser hereby accepts the quotation contained herein and agrees that by acceptance the said quotation and all of the pages shown in the Table of Contents shown on Page 2 hereof shall constitute a binding contract of purchase and sale enforceable in accordance with the terms and conditions hereof.

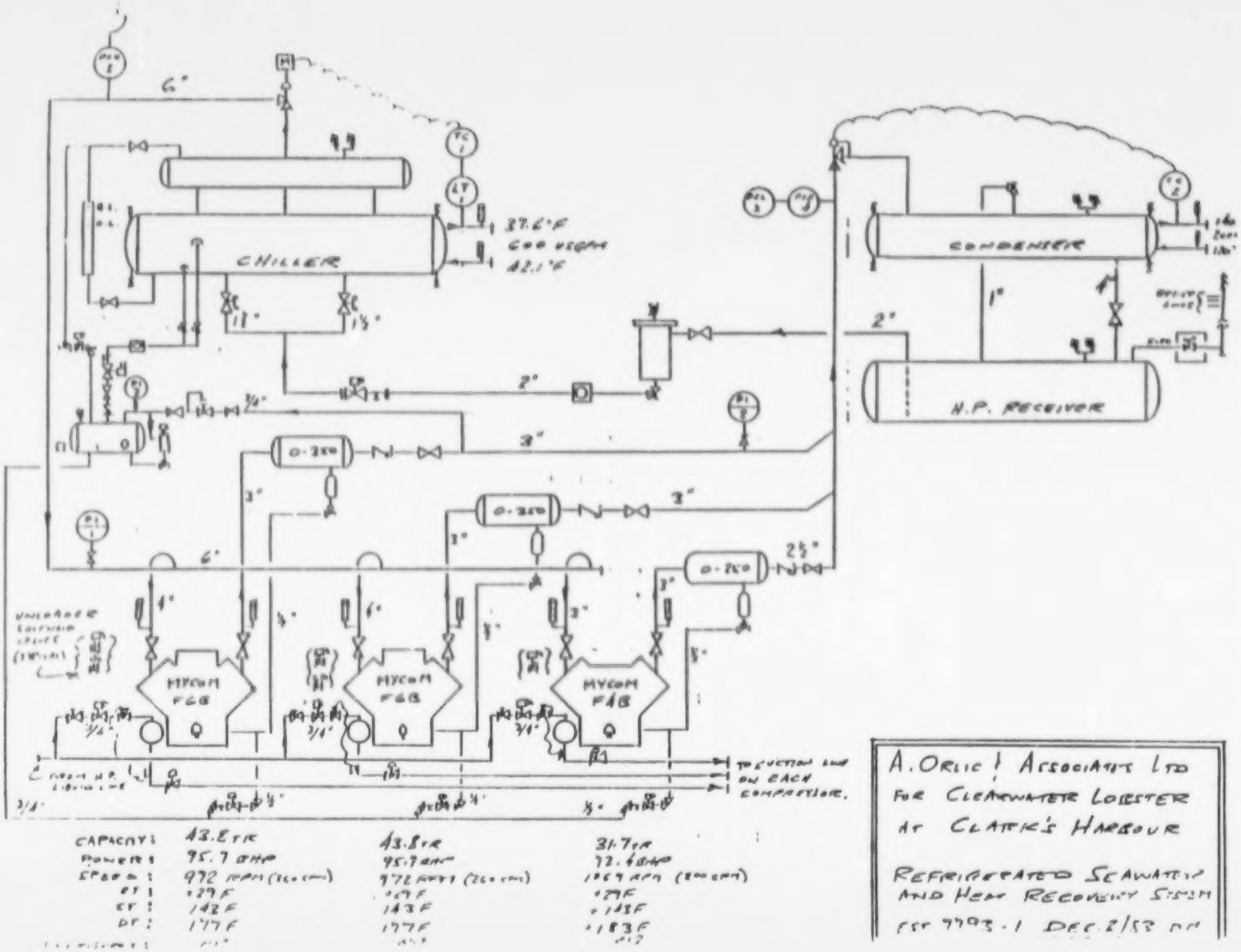
ACCEPTED THIS ....day of ....19.....

.... Full legal name of Purchaser	By .... Signature of Purchaser
.... Witness to Purchaser's signature	.... Full name of signing officer (please print)
	.... Official title of signing officer

VENDOR'S APPROVAL

Approved this ....day of ....19.....

.... Full name of authorized officer	**J. H. LOCK & SONS LIMITED**
.... Official title of authorized officer	By .... Signature of Vendor


6"
CHILLER
37.6°F
600 USGPM
42.1°F
1½"
1½"
2"
3"
3"
3"
3"
0-250
0-250
0-250
2½"
6"
CONDENSER
H.P. RECEIVER
1"
2"
MYCOM F6B
MYCOM F6B
MYCOM F4B
UNLOADER SOLENOID VALVES (TYPICAL)
3/4"
FROM H.P. LIQUID LINE
TO SUCTION LINE ON EACH COMPRESSOR.
CAPACITY: 43.8TR 43.8TR 31.7TR
POWER: 95.7 BHP 95.7 BHP 73.6 BHP
SPEED: 972 RPM (260 cm) 972 RPM (260 cm) 1069 RPM (200 cm)
ST: 29F 29F 29F
ET: 143F 143F 143F
DT: 177F 177F 183F
A. ORLIC & ASSOCIATES LTD
FOR CLEARWATER LOBSTER
AT CLARK'S HARBOUR
REFRIGERATED SEAWATER
AND HEAT RECOVERY SYSTEM
EST 7793.1 DEC.2/83

J. H. LOCK & SONS LIMITED
REFRIGERATION • AIR CONDITIONING • HEAT EXCHANGERS • STEEL FABRICATION

HEAD OFFICE & PLANT: 150 PERTH AVENUE, TORONTO, ONTARIO M6P 3X4
TELEPHONE: 416-531-1186, TELEX: 06-219525
DISTRICT OFFICES: DARTMOUTH — MONTREAL — TORONTO — CALGARY
IN B.C.: CORY LOCK LIMITED, VANCOUVER

Maritime District Office
19 Acadia Street
Woodside Ocean Industries Park
DARTMOUTH, Nova Scotia
B2Y 2N1
Tel: (902) 469-6642
Telex: 019-21704

December 21, 1983

A. ORLIC & ASSOCIATES LIMITED
6080 Young Street, Suite 506
Halifax, Nova Scotia
B3K 5L2

Attention: Mr. J. Linton, P. Eng.

Dear Jeff:

Confirming our telephone conversation today, our Quotation/ Contract contains the following typrographical errors:

1) Chiller seawater outlet temperature should read 37.6°F, not 37.1°F.

2) Condenser shellside conditions should read as follows:

R12
Inlet: 143°F Sat. Temp./179°F Actual
Outlet: 143°F Sat. Liquid
Flow: 34,122 lb/hr.
DWP: 300 PSIG

We trust that this is acceptable to you and apologize for the errors.

Yours sincerely,

Daniel Moscovitch, P.Eng.
Maritime District Engineer

cc: Clearwater Lobsters Ltd.
Mr. J. Risley

DISTRIBUTING
EQUIPMENT
ACROSS CANADA

TERMS AND CONDITIONS SHOWN ON REVERSE SIDE
TERMES ET CONDITIONS INDIQUES AU REVERS

C.2 - Cold Seawater Plate Heat Exchanger

ALFA-LAVAL LIMITED

HEAT EXCHANGER

SPECIFICATION SHEET

YOUR JOB NO
CUSTOMER CLEARWATER LOBSTER — YOUR INQUIRY NO
ADDRESS NOVA SCOTIA — OUR REFERENCE NO 9020- 1
PLANT LOCATION NOVA SCOTIA — DATE 84-1-18

SERVICE OF UNIT SEA WATER INTERCHANGER — Item No. 1 — Alt. No.
TYPE A15-BFG — NO REQ'D 1 — CONNECTED IN
TOTAL SURFACE 3833. ft.² — SURFACE PER EXCH ft.²

GUARANTEED PERFORMANCE

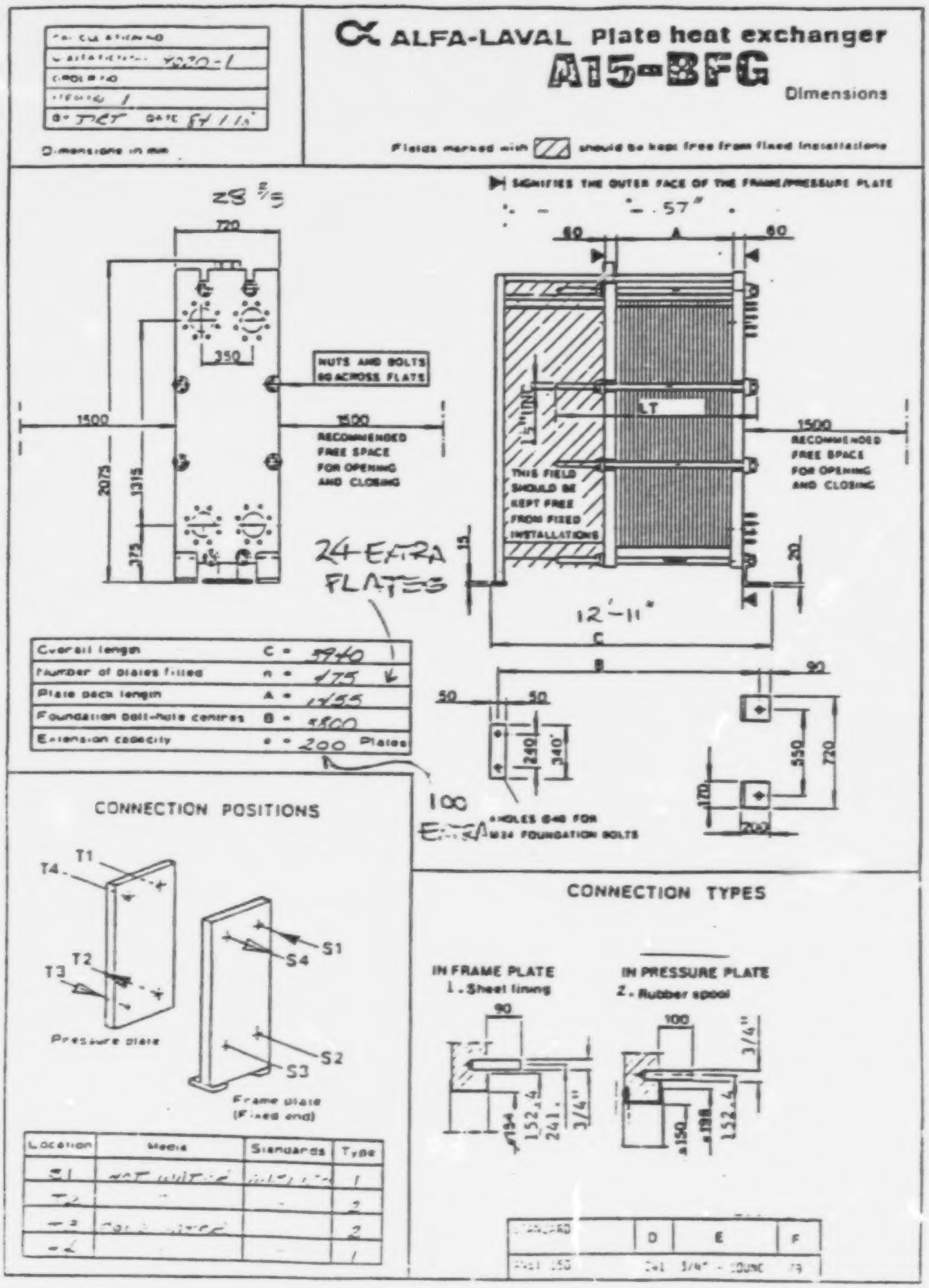
	HOT SIDE	COLD SIDE
FLUID CIRCULATED	SEA WATER	SEA WATER
TOTAL FLUID ENTERING		
VAPOR		
LIQUID L/S	37.8 (594.7 USGM)	34.7 (550.5 USGM)
STEAM		
NON CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
SPECIFIC HEAT		
SPECIFIC GRAVITY		
THERMAL CONDUCTIVITY		
VISCOSITY		
LATENT HEAT - VAPORS		
TEMPERATURE IN °C	15.5	6.15
TEMPERATURE OUT °C	5.6	14.9
OPERATING PRESSURE		
PRESSURE DROP KPA	90. 1= PSI	90. 1= PSI

HEAT EXCHANGED KW 1569.
LOG MEAN TEMP DIFFERENCE .96 C°

CONSTRUCTION

DESIGN PRESSURE - PSI IN G.	100.	100.
TEST PRESSURE - PSI IN G.	150.	150.
DESIGN TEMPERATURE °C	110.	110.

CHANNEL SEAL NITRILE RUBBER GASKETS
MATERIAL TITANIUM — THICKNESS
DIMENSIONS See Dimension Sketch
SHIPPING WEIGHT 6600 LB NET WEIGHT 6160 LB FLOODED WEIGHT 8040 LB
REMARKS



ALFA-LAVAL Plate heat exchanger

A15-BFG

Dimensions

[illegible]	
[illegible]	Y220-1
[illegible]	
[illegible]	1
BY JRT	DATE 84 1.15

Dimensions in mm

Fields marked with ▨ should be kept free from fixed installations

▶ SIGNIFIES THE OUTER FACE OF THE FRAME/PRESSURE PLATE

Overall length	C =	5940
Number of plates fitted	n =	175
Plate pack length	A =	1455
Foundation bolt-hole centres	B =	5800
Extension capacity	e =	200 Plates

24 EXTRA FLATES

100 EXTRA

28 2/5
720
350
NUTS AND BOLTS 80 ACROSS FLATS
1500
1500 RECOMMENDED FREE SPACE FOR OPENING AND CLOSING
2075
1315
375
~ 57"
60
A
60
15" LINE
LT
THIS FIELD SHOULD BE KEPT FREE FROM FIXED INSTALLATIONS
1500 RECOMMENDED FREE SPACE FOR OPENING AND CLOSING
15
20
12'-11"
C
B
90
50
50
240
340
HOLES Ø40 FOR M24 FOUNDATION BOLTS
550
720
170
200

CONNECTION POSITIONS

T1
T4
T2
T3
Pressure plate
S1
S4
S2
S3
Frame plate (Fixed end)

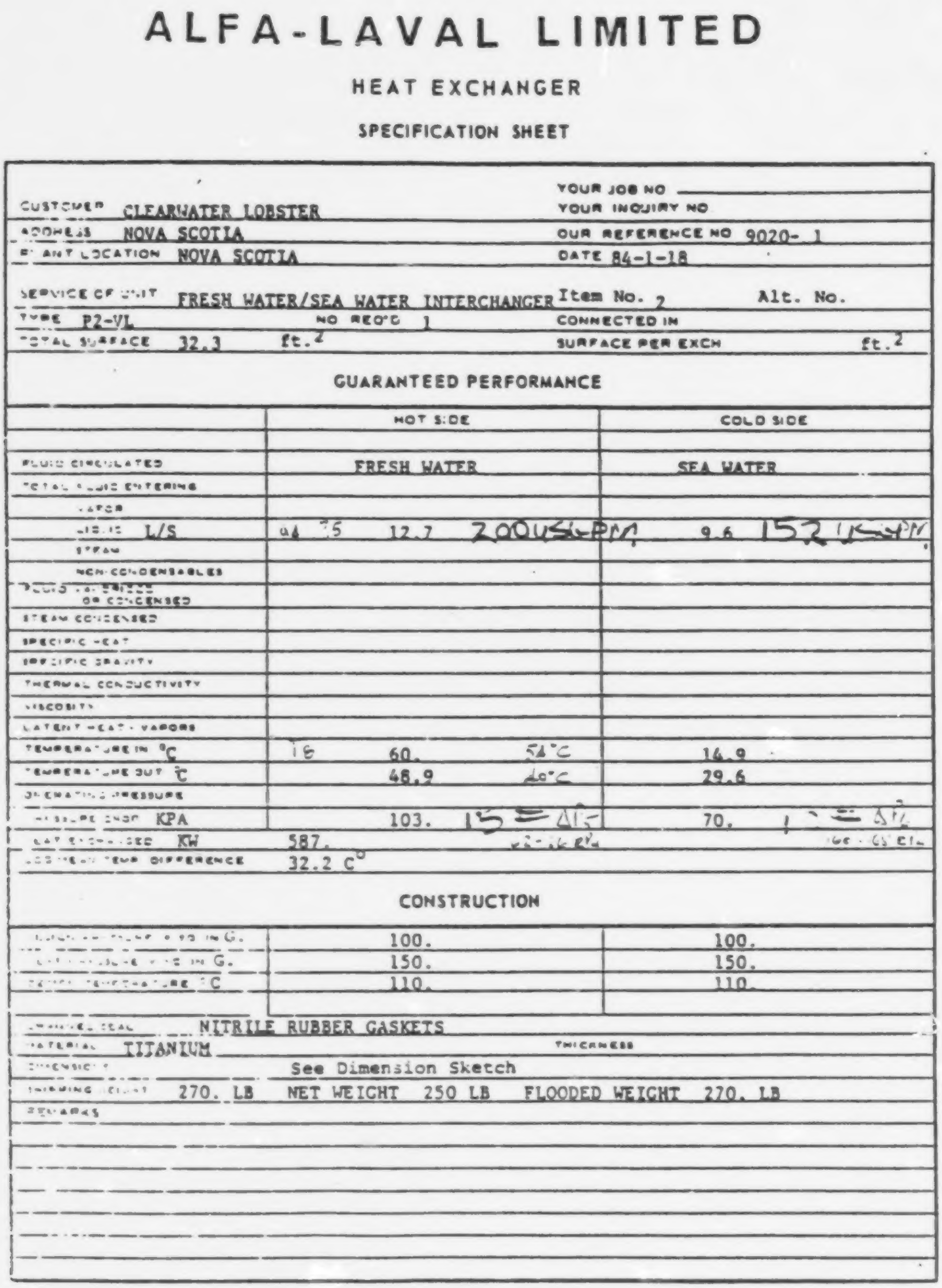
Location	Media	Standards	Type
S1	HOT WATER	[illegible]	1
T2	"	-	2
T3	COLD WATER		2
T4	-	-	1

CONNECTION TYPES

IN FRAME PLATE
1. Sheet lining
90
154
152.4
241
3/4"
IN PRESSURE PLATE
2. Rubber spool
100
3/4"
150
198
152.4

STANDARD	D	E	F
ANSI 150	241	3/4" - 10UNC	[illegible]

C.3 - Waste Heat Plate Heat Exchanger



ALFA-LAVAL LIMITED

HEAT EXCHANGER

SPECIFICATION SHEET

YOUR JOB NO
CUSTOMER CLEARWATER LOBSTER — YOUR INQUIRY NO
ADDRESS NOVA SCOTIA — OUR REFERENCE NO 9020- 1
PLANT LOCATION NOVA SCOTIA — DATE 84-1-18
SERVICE OF UNIT FRESH WATER/SEA WATER INTERCHANGER — Item No. 2 — Alt. No.
TYPE P2-VL — NO REQ'D 1 — CONNECTED IN
TOTAL SURFACE 32.3 ft.^{2} — SURFACE PER EXCH ft.^{2}

GUARANTEED PERFORMANCE

	HOT SIDE	COLD SIDE
FLUID CIRCULATED	FRESH WATER	SEA WATER
TOTAL FLUID ENTERING		
VAPOR		
LIQUID L/S	ud 75 12.7 200USGPM	9.6 152USGPM
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
SPECIFIC HEAT		
SPECIFIC GRAVITY		
THERMAL CONDUCTIVITY		
VISCOSITY		
LATENT HEAT - VAPORS		
TEMPERATURE IN °C	18 60. 54°C	14.9
TEMPERATURE OUT °C	48.9 40°C	29.6
OPERATING PRESSURE		
PRESSURE DROP KPA	103. 15 = ΔP	70. 1 = ΔP
HEAT EXCHANGED KW	587. [illegible]	[illegible]
LOG MEAN TEMP DIFFERENCE	32.2 C°	

CONSTRUCTION

[illegible] PSI IN G.	100.	100.
TEST PRESSURE PSI IN G.	150.	150.
DESIGN TEMPERATURE °C	110.	110.

[illegible] SEAL NITRILE RUBBER GASKETS
MATERIAL TITANIUM — THICKNESS
DIMENSIONS See Dimension Sketch
SHIPPING WEIGHT 270. LB NET WEIGHT 250 LB FLOODED WEIGHT 270. LB
REMARKS

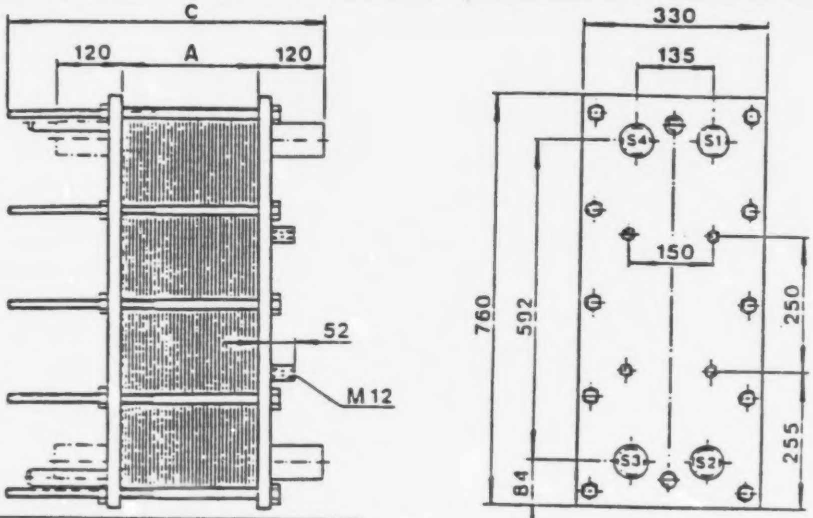
CALCULATION NO	
QUOTATION NO	9020-1
ORDER NO	
ITEM NO	2
BY DET	DATE 84-1-18

Dimensions in mm

ALFA-LAVAL Plate heat exchanger type P2 -VL

Dimensions

Fields marked with ▨ should be kept free from fixed installations

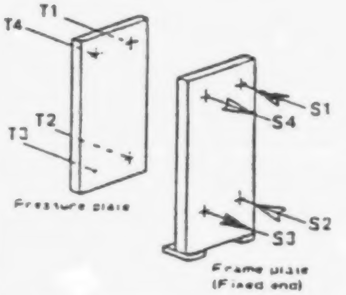

C
120
A
120
52
M12
330
135
S4
S1
150
760
592
250
255
84
S3
S2

Number of plates fitted	n = 25	
Plate pack length	A = 97.5	
Overall length	C = 395	
Extension capacity	e = 24	Plates

← 2 EXTRA

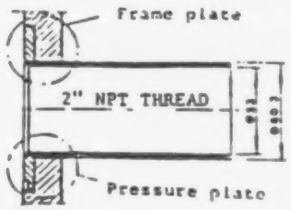
← 23 EXTRA

CONNECTION POSITIONS


T1
T4
T2
T3
Pressure plate
S1
S4
S2
S3
Frame plate
(Fixed end)

Location	Media	Standards	Type
S1	FRESH WATER	NPT	2"
S4	"	"	"
S2	SEA WATER	"	"
S3	"	"	"

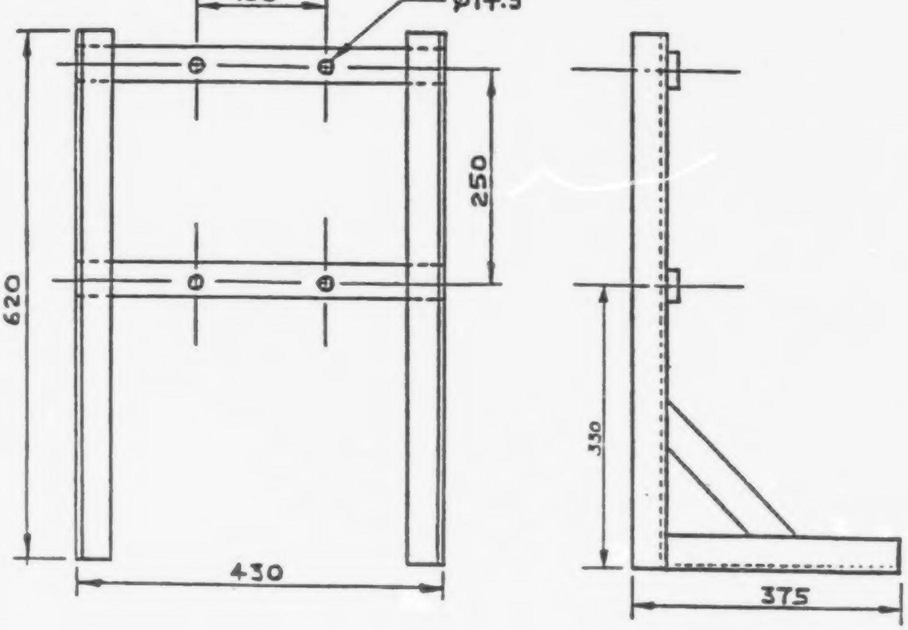
CONNECTION TYPES


Frame plate
2" NPT THREAD
Pressure plate

CALCULATION NO
QUOTATION NO 9020-1
ORDER NO
ITEM NO 2
BY DET DATE 84.1.18

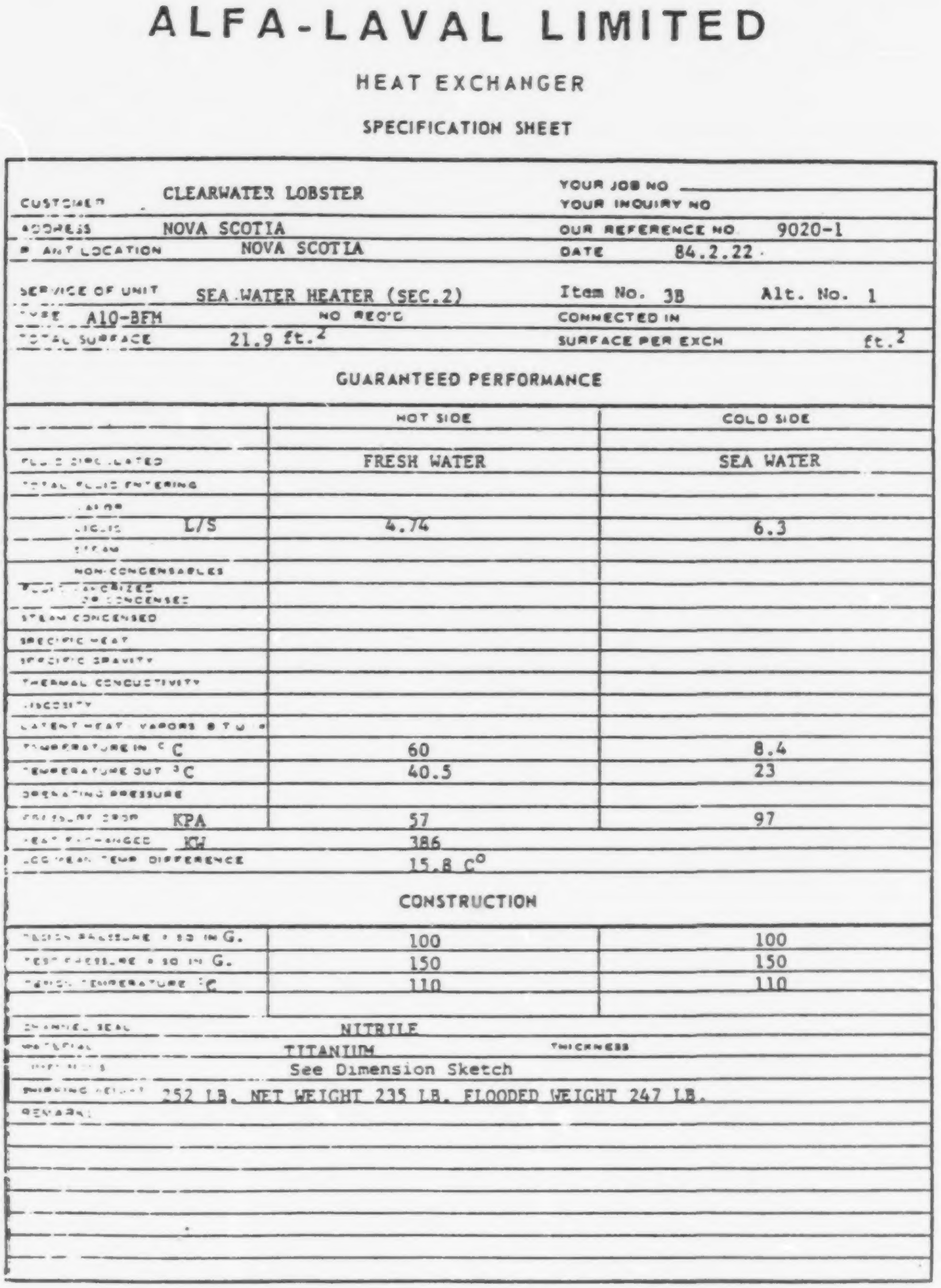
Dimensions in mm

ALFA-LAVAL Plate heat exchanger
P2-VL
FLOOR MOUNTING BRACKET Dimensions



150
ϕ14.5
250
620
430
330
375

C.4 - Warm Seawater Plate Heat Exchanger



ALFA-LAVAL LIMITED

HEAT EXCHANGER

SPECIFICATION SHEET

CUSTOMER CLEARWATER LOBSTER
YOUR JOB NO
YOUR INQUIRY NO
ADDRESS NOVA SCOTIA
OUR REFERENCE NO 9020-1
PLANT LOCATION NOVA SCOTIA
DATE 84.2.22

SERVICE OF UNIT SEA WATER HEATER (SEC.2)
Item No. 3B Alt. No. 1
TYPE A10-BFM
NO REQ'D
CONNECTED IN
TOTAL SURFACE 21.9 $ft.^2$
SURFACE PER EXCH $ft.^2$

GUARANTEED PERFORMANCE

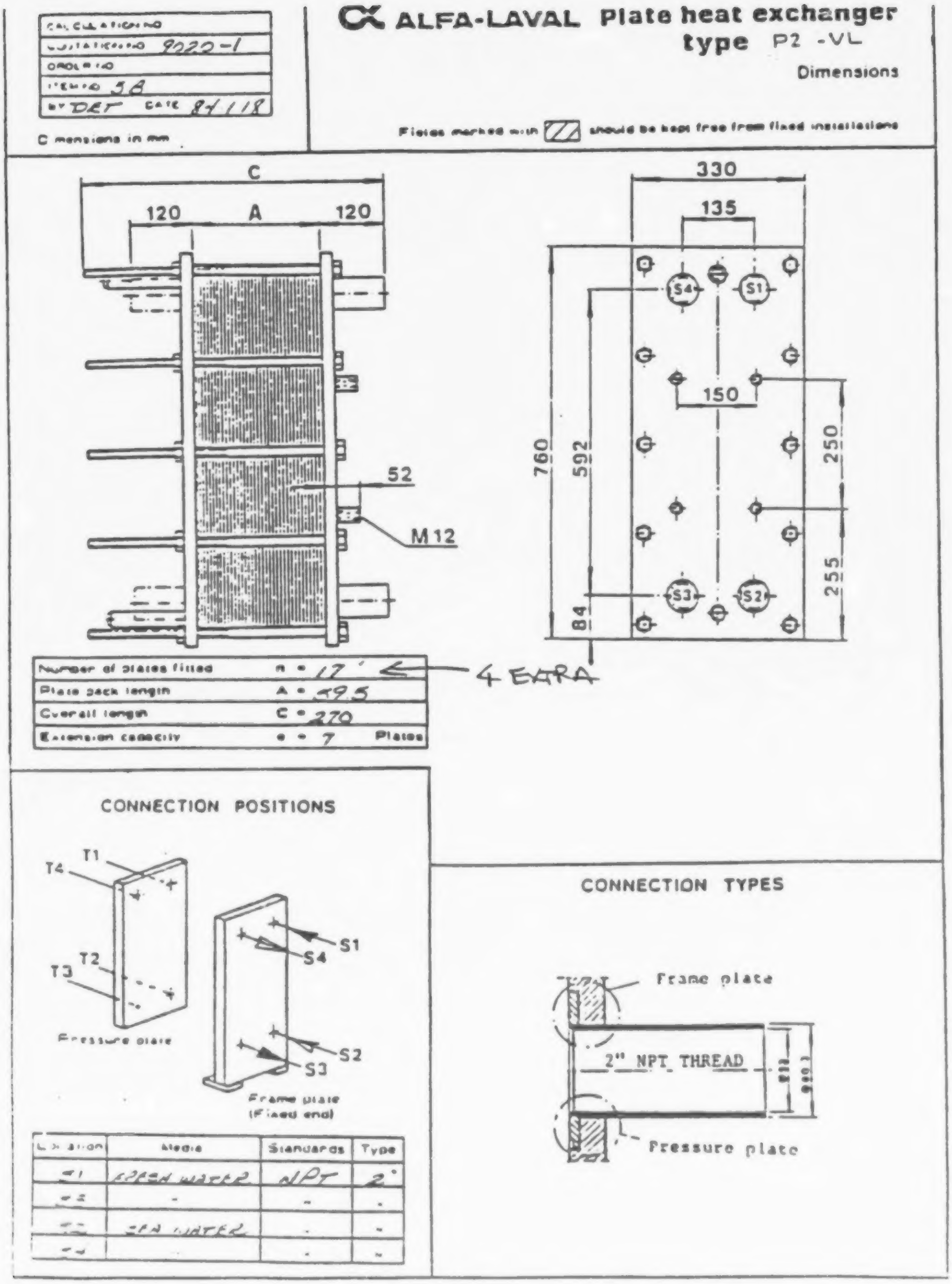
	HOT SIDE	COLD SIDE
FLUID CIRCULATED	FRESH WATER	SEA WATER
TOTAL FLUID ENTERING		
VAPOR		
LIQUID L/S	4.74	6.3
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
SPECIFIC HEAT		
SPECIFIC GRAVITY		
THERMAL CONDUCTIVITY		
VISCOSITY		
LATENT HEAT - VAPORS B.T.U. #		
TEMPERATURE IN °C	60	8.4
TEMPERATURE OUT °C	40.5	23
OPERATING PRESSURE		
PRESSURE DROP KPA	57	97

HEAT EXCHANGED KW 386
LOG MEAN TEMP DIFFERENCE 15.8 C°

CONSTRUCTION

DESIGN PRESSURE # SQ IN G.	100	100
TEST PRESSURE # SQ IN G.	150	150
DESIGN TEMPERATURE °C	110	110

CHANNEL SEAL NITRILE
MATERIAL TITANIUM THICKNESS
DIMENSIONS See Dimension Sketch
SHIPPING WEIGHT 252 LB. NET WEIGHT 235 LB. FLOODED WEIGHT 247 LB.
REMARKS



CALCULATION NO	
QUOTATION NO	9022-1
ORDER NO	
ITEM NO	3B
BY DET	DATE 84/1/18

Dimensions in mm

ALFA-LAVAL Plate heat exchanger type P2 -VL

Dimensions

Fields marked with ▨ should be kept free from fixed installations

Number of plates fitted	n = 17
Plate pack length	A = 59.5
Overall length	C = 270
Extension capacity	e = 7 Plates

← 4 EXTRA

CONNECTION POSITIONS

Location	Media	Standards	Type
S1	FRESH WATER	NPT	2"
S2	-	-	-
S3	SEA WATER	-	-
S4		-	-

CONNECTION TYPES

C
120
A
120
52
M12
330
135
S4
S1
150
760
592
250
255
84
S3
S2
T1
T4
T2
T3
Pressure plate
S1
S4
S2
S3
Frame plate
(Fixed end)
Frame plate
2" NPT THREAD
Pressure plate

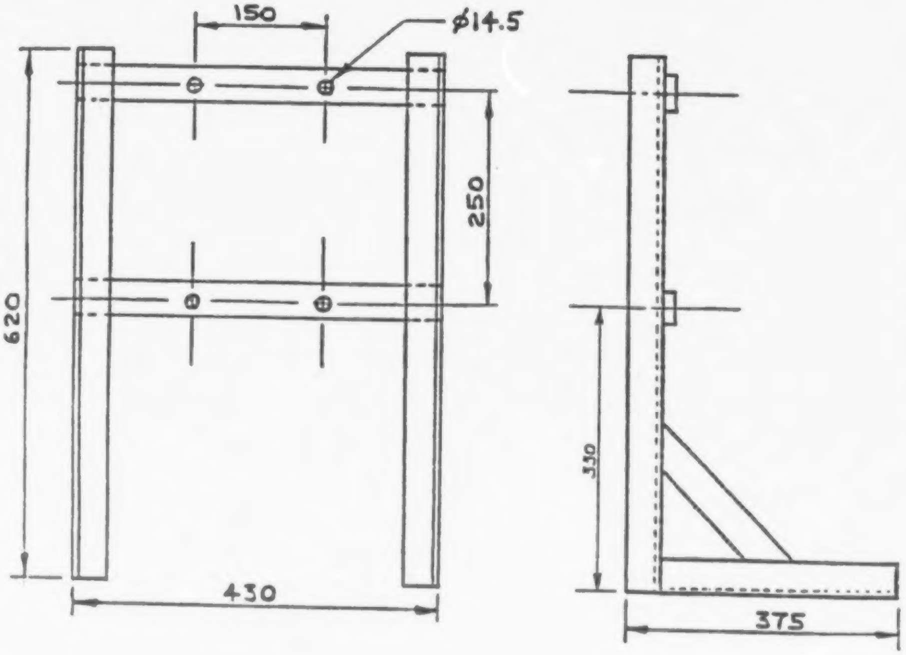
CALCULATION NO	
QUOTATION NO	7020-1
CIRCLE NO	
ITEM NO	2d
BY IET	DATE 84.1.18

Dimensions in mm

ALFA-LAVAL Plate heat exchanger

P2-VL

FLOOR MOUNTING BRACKET Dimensions


150
ϕ14.5
250
620
430
330
375

C.5 - Warm Seawater Heat Recovery Plate Heat Exchanger

ALFA-LAVAL LIMITED

HEAT EXCHANGER

SPECIFICATION SHEET

YOUR JOB NO

CUSTOMER CLEARWATER LOBSTER — YOUR INQUIRY NO

ADDRESS NOVA SCOTIA — OUR REFERENCE NO 9020-1

PLANT LOCATION NOVA SCOTIA — DATE 84.2.22

SERVICE OF UNIT SEA WATER HEATER (SEC.1) — Item No. 3A Alt. No. 1

TYPE A10-BFM — NO REQ'D — CONNECTED IN

TOTAL SURFACE 69.7 ft.^{2} — SURFACE PER EXCH ft.^{2}

GUARANTEED PERFORMANCE

	HOT SIDE	COLD SIDE
FLUID CIRCULATED	SEA WATER	SEA WATER
TOTAL FLUID ENTERING		
VAPOR		
LIQUID L/S	6.3	6.3
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
SPECIFIC HEAT		
SPECIFIC GRAVITY		
THERMAL CONDUCTIVITY		
VISCOSITY		
LATENT HEAT - VAPORS		
TEMPERATURE IN °C	20.	.5
TEMPERATURE OUT °C	12.1	8.4
OPERATING PRESSURE		
PRESSURE DROP KPA	94	92
HEAT EXCHANGED KW	210.7	
LOG MEAN TEMP DIFFERENCE	11.6 C°	

CONSTRUCTION

DESIGN PRESSURE # SQ IN G.	100	100
TEST PRESSURE # SQ IN G.	150	150
DESIGN TEMPERATURE °C	110	110

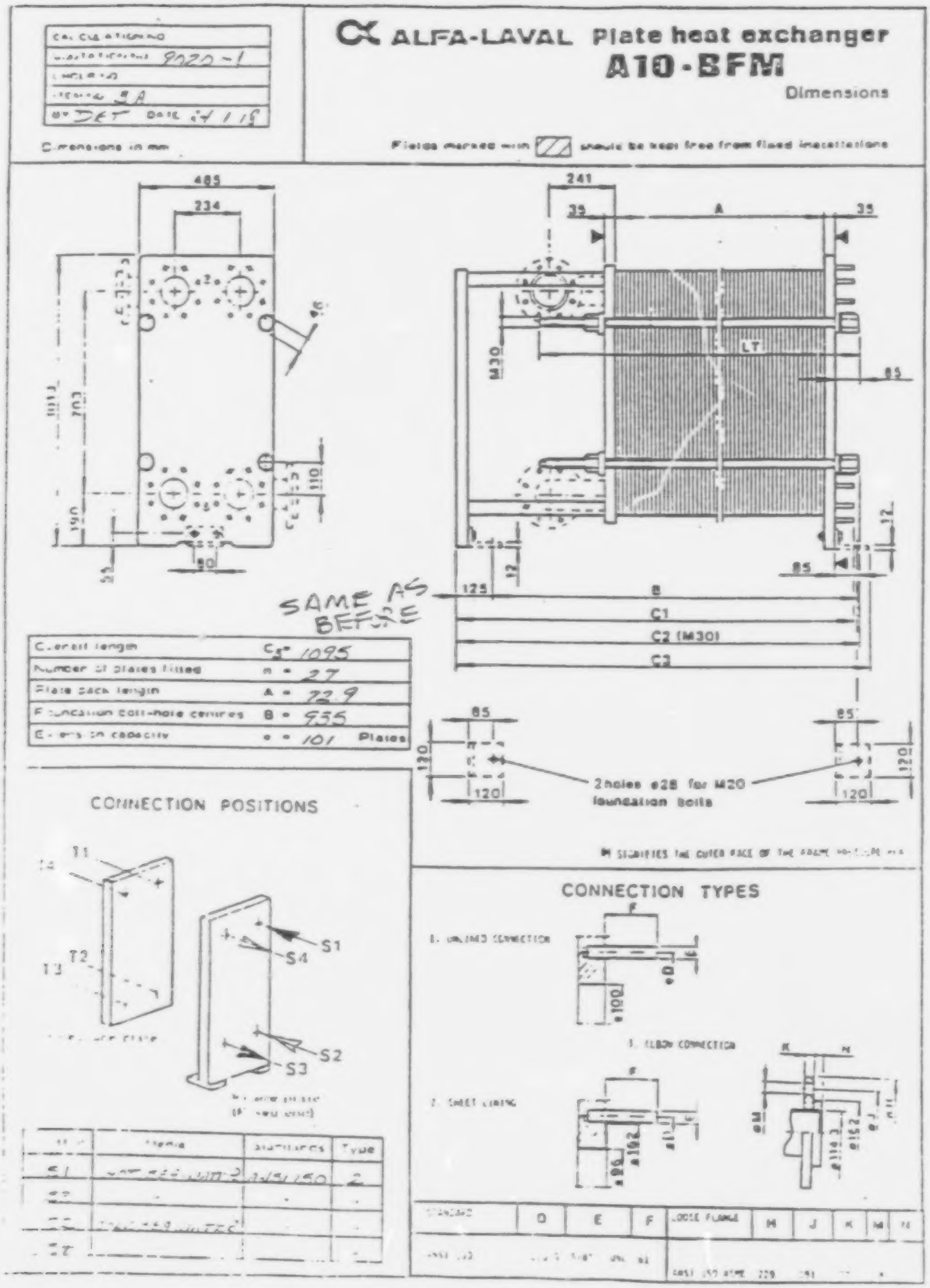
CHANNEL SEAL NITRILE GASKETS

MATERIAL TITANIUM — THICKNESS

DIMENSIONS See Dimension Sketch

SHIPPING WEIGHT 655 LB. NET WEIGHT 611 LB. FLOODED WEIGHT 643 LB.

REMARKS



CALCULATION NO	
[illegible]	9020-1
[illegible]	
[illegible]	3A
BY DET	DATE 24 1 18

Dimensions in mm

ALFA-LAVAL Plate heat exchanger
A10-BFM
Dimensions

Fields marked with ▨ should be kept free from fixed installations

SAME AS BEFORE

Overall length	C_5 = 1095
Number of plates fitted	n = 27
Plate pack length	A = 72.9
Foundation bolt-hole centres	B = 935
Extension capacity	e = 101 Plates

2 holes ø28 for M20 foundation bolts

▶ SIGNIFIES THE OUTER FACE OF THE FRAME [illegible]

CONNECTION POSITIONS

[illegible]	Medium	Standards	Type
S1	[illegible]	[illegible] 150	2
S2	.	.	.
S3	[illegible]	.	.
S4			.

CONNECTION TYPES

1. UNLINED CONNECTION

2. SHEET LINING

3. ELBOW CONNECTION

STANDARD	D	E	F	LOOSE FLANGE	H	J	K	M	N
ANSI 150	[illegible]	[illegible]	[illegible]	ANSI 150 ASME	229	191	[illegible]	[illegible]	

485
234
241
35
A
35
M30
LT
85
110
190
703
1011
22
80
12
12
85
125
B
C1
C2 (M30)
C3
85
85
120
120
120
120
T1
T4
T2
T3
S1
S4
S2
S3
F
ø100
ø102
ø96
K
H
øM
ø114.3
ø152

C.6 - Seawater Supply Pumps

CLEARWATER LOBSTERS LIMITED

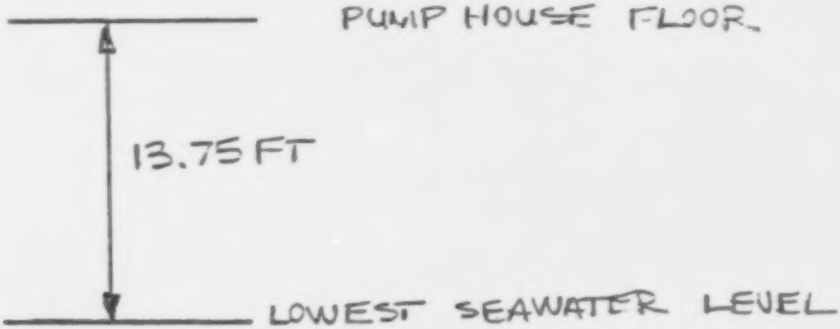
A. 2X - Seawater Supply Pump (One required)

FLOW RATE: 700 USGPM

TDH 52 PSIG (120 ft) - at pump discharge flange.

TYPE OF PUMP: Vertical

LENGTH OF PUMP TO SUIT FOLLOWING CONDITIONS



PUMP CONSTRUCTION

- cast iron body
- 316SS impeller
- 316SS pump shaft

PUMP SELECTION (EQUAL TO):

Gould Model 3171 Vertical Pump
Size 4 x 6 - 13, Group "M", 1750 RPM

73% Efficiency, 31 BHP

Impeller Size - 11 3/4"

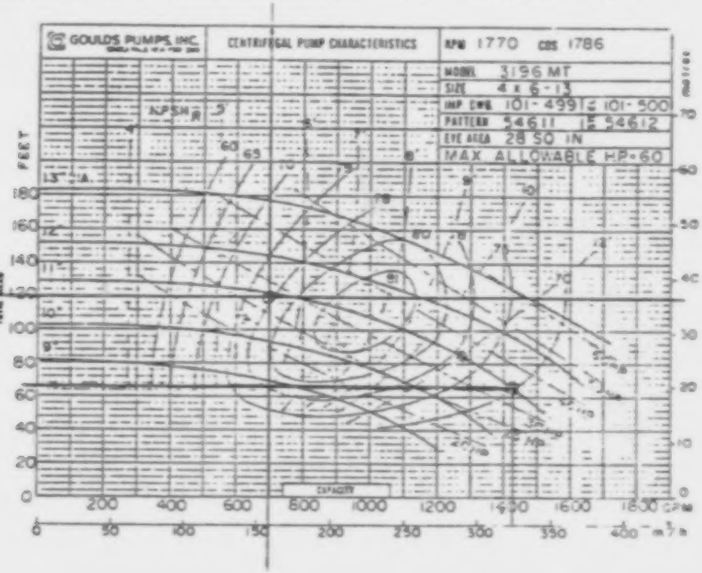
MOTOR:

40 HP, 575/3/60, 1750 RPM

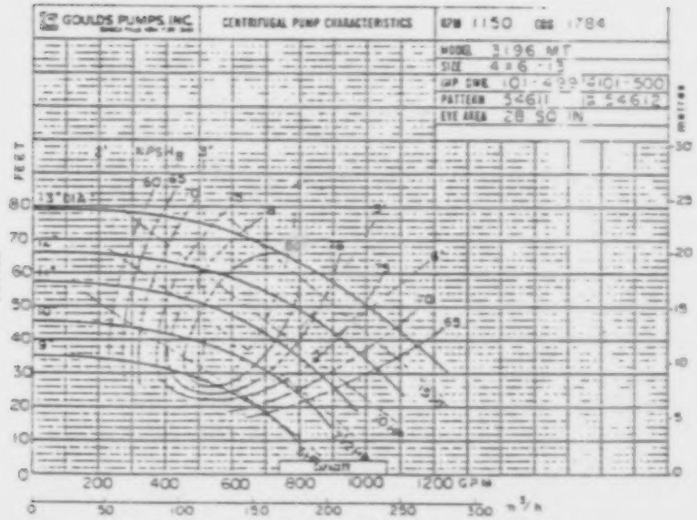
TEFC Motor

Customer [illegible] Inquiry No ______ Date ______
Service [illegible] Item No ______ P.O. No ______ Date ______
F.O. No ______ 700 GPM, 120 TDH, 1770 RPM, 77 % Eff. CDS No ______

1770 R.P.M.



1150 R.P.M.



C.7 - Seawater Circulating Pumps

B, 4 - Seawater Recirculating Pumps (four required)

Flowrate	- 1335 USGPM
TDH	- 28,2 PSIG (65 ft.).
Type of Pump	- Vertical
Lenth of Pump	- 7 ft.

PUMP CONSTRUCTION

- cast iron body
- 316SS impeller
- 316SS pump shaft

MOTOR

30 HP, 575/3/60/1750 RPM Motor
TEFC

SMART TURNER

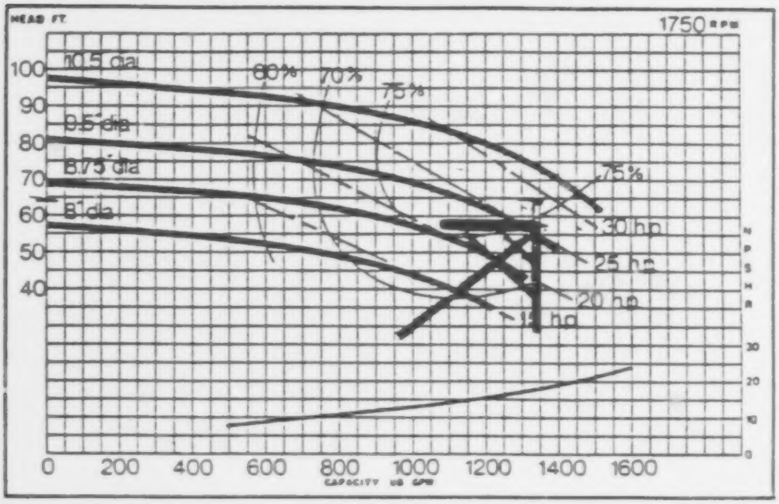
PERFORMANCE

VERTICAL
5LZ

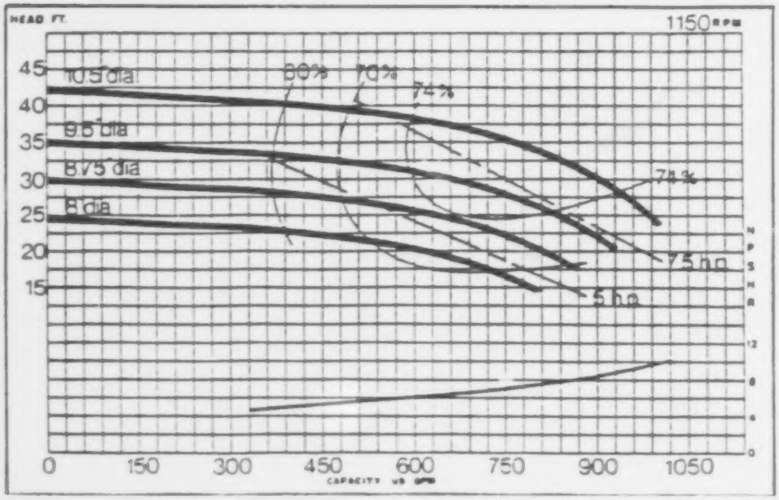
PAGE H-8.15
DECEMBER 1, 1981

SIZE: 5" x 6"
MAXIMUM SHPERE: 2³/₁₆"

IMPELLER: 04891
MAXIMUM DIAMETER: 10½"
MINIMUM DIAMETER: 8"



8041-B-2



8041-B-3

C.8 - Waste Seawater Pumps

C. 2 - Waste Seawater Pumps (two required)

Flowrate - 550 USGPM

TDH - 38.8 PSIG (89.2 ft.)

Type of Pump - Vertical

Length of Pump - 7 ft.

PUMP CONSTRUCTION

- cast iron body
- 316SS impeller
- 316SS pump shaft

MOTOR

20 HP, 575/3/60/1750 RPM Motor
TEFC

SMART TURNER

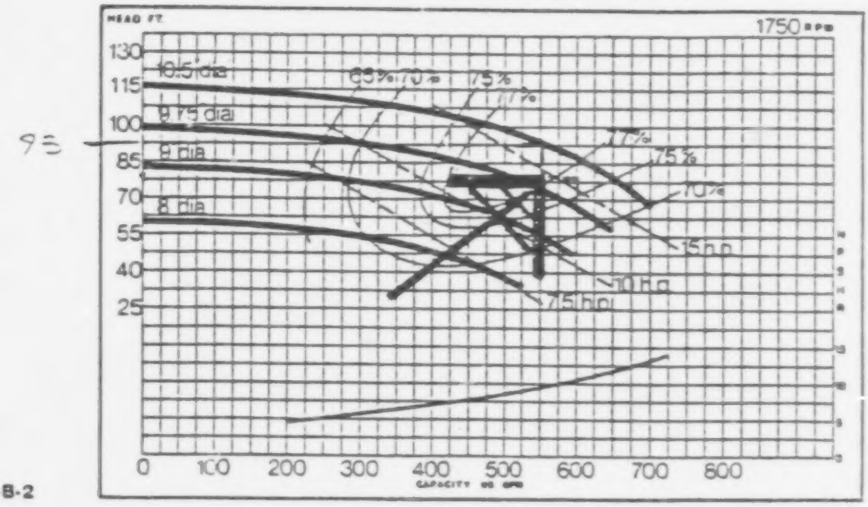
PERFORMANCE

VERTICAL
3LG

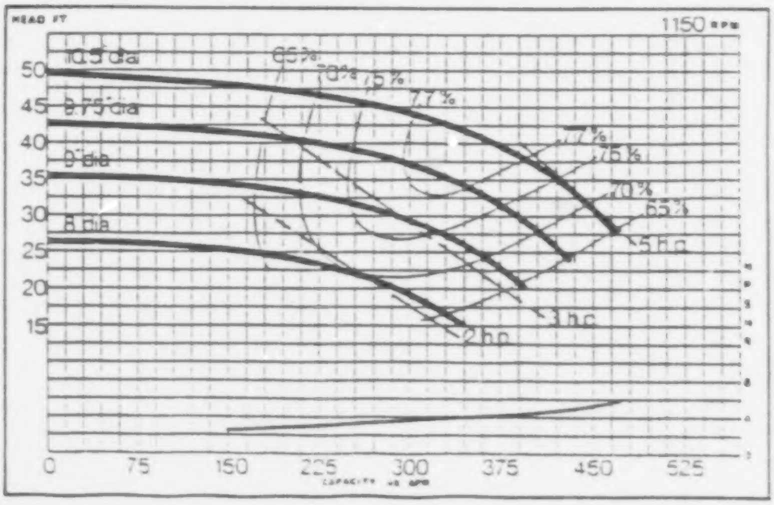
PAGE H-8.11
DECEMBER 1, 1981

SIZE: 3" x 4"
MAXIMUM SPHERE: 3¹/₃₂"

IMPELLER: 04861
MAXIMUM DIAMETER: 10¹/₂"
MINIMUM DIAMETER: 8"



8027-B-2



8027-B-3

C.9 - Hot Water Circulating Pumps

E. 2 - Hot Water Circulating Pumps (two required)

Flowrate - 200 USGPM

TDH - 35 PSIG (80.5 ft.)

Type of Pump - Vertical In-Line

Pump Construction - All Iron

Operating Temperature - 140°F

PUMP SELECTION

Hot water circulator to be heavy industrial type suitable for year round continuous use.

Equal to:

Gould Model 3996MT in-line process pump.

MOTOR

7 1/2 HP, 575/3/60/1750 RPM Motor
TEFC

Goulds Model 3996 MT

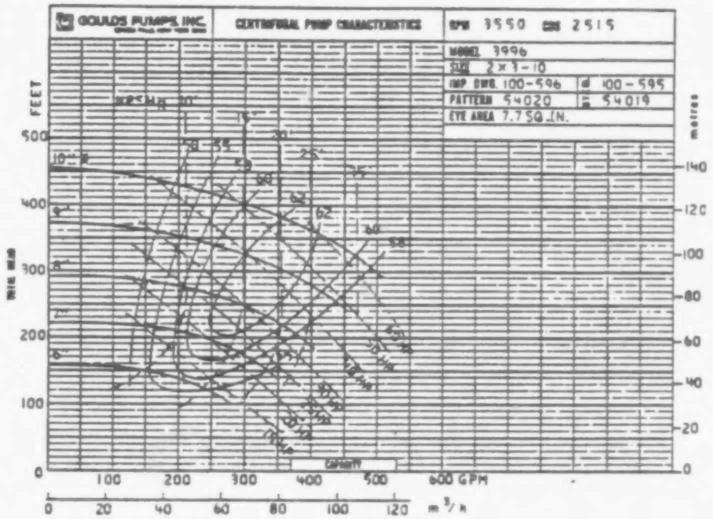
60 Hz Performance Curves

725.2C10
April 30, 1977
(New)

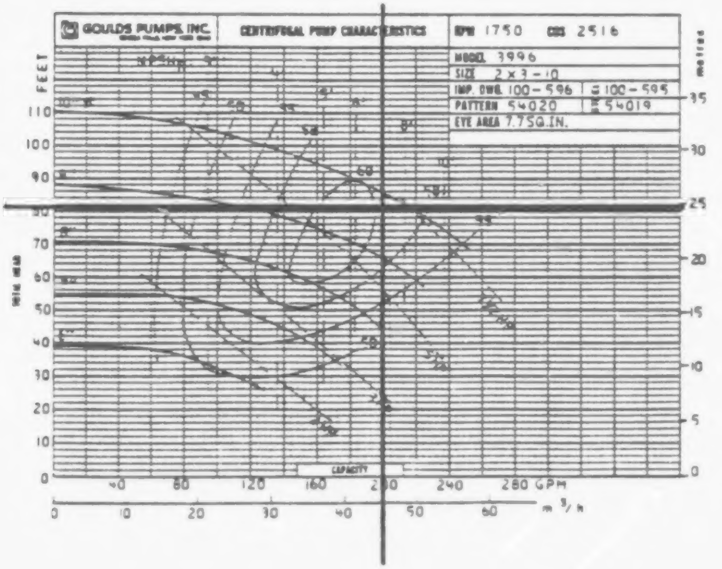
Customer A. ORLIC & ASSOCIATES LTD. Inquiry No.______ Date ______
Service Hot water circulating Item No.______ P.O. No. ______ Date ______
F.O. No.______ : 200 GPM; 80½ TDH; 1750 RPM; 59 % Eff.; CDS No.______

16

ATLANTIC BRIDGE CO. LTD.
LUNENBURG, N. S.



3550 R.P.M.



1750 R.P.M.

C.10 - Seawater Return Pumps

D. 2 - Waste Seawater Pumps (two required)

Flowrate - 100 USGPM

TDH - 20 PSIG (46 ft.)

Type of Pump - Vertical

Length of Pump - 4 ft.

PUMP CONSTRUCTION

- cast iron body
- 316SS impeller
- 316SS pump shaft

MOTOR

3 HP, 575/3/60/1750 RPM Motor
TEFC

SMART TURNER

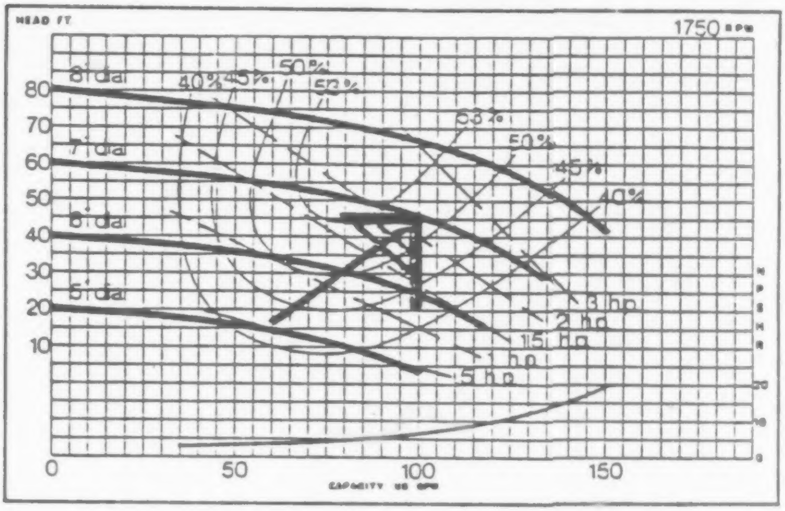
PERFORMANCE

VERTICAL
1 ½ GC

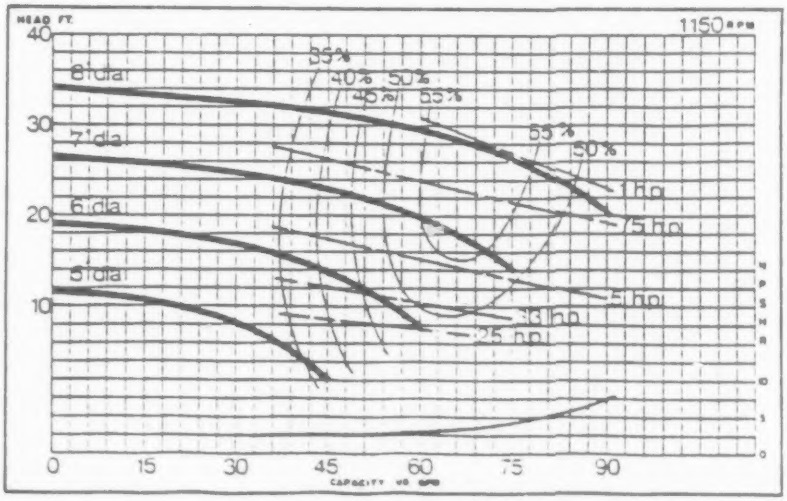
PAGE H-8.1
DECEMBER 1, 1981

SIZE: 1½" x 1½"
MAXIMUM SPHERE: 11/16"

IMPELLER: 00071
MAXIMUM DIAMETER: 8"
MINIMUM DIAMETER: 5"



8262-B-2



8262-B-3

APPENDIX 'D'

Table D.1; Statement of Work

Table D.2; Pressures

Table D.3; Temperatures

Table D.4: Flow Ratae

Table D.5; Electrical Loads

TABLE D-1

STATEMENT OF WORK

HEAT PUMP PERFORMANCE MONITORING

Application of a Heat Pump to Energy Recovery and Process Temperature Control at Clearwater Lobster Ltd., Bedford, Nova Scotia

1. Specify purchase and install measuring and recording instrumentation.

2. Record and document all measurements of temperatures, flows, pressures and electrical and mechanical power consumption sufficient to calculate a seasonal energy balance. The schedule of measurements to be taken will be as in an agreed piping and instrumentation diagram provided by the contractor and approved by NRC. The recording method will be at the contractor's discretion to provide the most economical approach according to plant site conditions and availability of skilled operators. All energy recovered or received by the heat pump and all energy supplied to the process equipment will be measured.

3. Maintain a log of the operation of the plant in order to identify any deficiency or unavailability, extent of operational supervision and of maintenance required and of the use of replacement equipment or spare parts.

4. Prepare a final report which will analyze the cost of installation and operation during the first year and project costs for future years to the point of lmature operation. The report will contain equipment specifications, flow diagrams, instrumentation and piping diagrams and photographic illustrations of plant and equipment failures, corrosion or fouling problems such as might arise.

5. Produce the final report incorporating the above items. Six copies of the final approved typewritten draft to be supplied with an AES C-20 word processor diskette of the text and tables. A set of camera ready copy of charts and diagrams suitable for reproduction is also required.

TABLE D-2

PRESSURES

SYMBOL	DESCRIPTION	UNITS
P1	Ambient Seawater Supply Pressure	kPa
P2	Recirculated Cold Seawater Supply Pressure	kPa
P3	Waste Seawater Supply Pressure	kPa
DP1	Differential Pressure of Ambient Seawater Stream across C.S.W.P.H.E.	kPa
DP2	Differential Pressure of Waste Seawater Stream across C.S.W.P.H.E.	kPa
DP3	Differential Pressure of Ambient Seawater Stream across H.P.E.	kPa
DP4	Differential Pressure of Recirculated Fresh Water Stream across H.P.C.	kPa
DP5	Differential Pressure of Recirculated Fresh Water Stream across W.H.P.H.E.	kPa
DP6	Differential Pressure of Waste Seawater Stream across W.H.P.H.E.	kPa

Readings: Sample readings taken every 2 min intervals

Stored: Average hourly values - at one hour intervals

Recorded: a) Average daily values - at 24 hour intervals

b) Average weekly values - at 168 hour intervals

TABLE D-3

TEMPERATURES

SYMBOL	DESCRIPTION	UNITS
T1	Temperature of Ambient Seawater Stream Entering C.S.W.P.H.E.	°C
T2	Temperature of Ambient Seawater Stream Leaving C.S.W.P.H.E.	°C
T3	Temperature of Waste Seawater Stream Entering C.S.W.P.H.E.	°C
T4	Temperature of Waste Seawater Stream Leaving C.S.W.P.H.E.	°C
T5	Temperature of Ambient Seawater Stream Entering H.P.E.	°C
T6	Temperature of Ambient Seawater Stream Leaving H.P.E.	°C
T7	Temperature of Recirculated Fresh Water Stream Entering H.P.C.	°C
T8	Temperature of Recirculated Fresh Water Stream Leaving H.P.C.	°C
T9	Temperature of Recirculated Fresh Water Stream Entering W.H.P.H.E.	°C
T10	Temperature of Recirculated Fresh Water Stream Leaving W.H.P.H.E.	°C
T11	Temperature of Recirculated Cold Seawater Stream Leaving C.S.W.R.R. to S.C.W.D.L.P.	°C

Readings: Sample readings every 2 min. intervals

Stored: Average hourly values - at one hour intervals

Recorded: a) average daily values - at 24 hour intervals

b) average weekly values - at 168 hour intervals

TABLE D-4

FLOW RATES

SYMBOL	DESCRIPTION	UNITS
Q1	Ambient Seawater Stream Flow (make-up) Rate through C.S.W.P.H.E. and H.P.E.	l/s
Q2	Waste Seawater Stream Flow Through C.S.W.P.H.E.	l/s
Q3	Recirculated Fresh Water Stream Flow Rate Through W.S.W.P.H.E.	l/s
Q4	Recirculated Fresh Water Stream Flow Rate Through W.S.W.P.H.E.	l/s
Q5	Ambient Seawater Stream Flow Rate to W.S.W.D.L.P.	l/s

Readings: Sample readings every 2 min. intervals

Stored: Average hourly values - at one hour intervals

Recorded: a) average daily values - at 24 hour intervals

b) average weekly values - at 168 hour intervals

TABLE D-5

ELECTRICAL LOADS

SYMBOL	DESCRIPTION	UNITS
KW1	Electrical Load of S.W.S.P.	KW
KW2	Electrical Load of H.P.	KW
KW3	Electrical Load of W.S.W.P.	KW
KW4	Electrical Load of S.W.C.P.	KW
KW5	Electrical Load of H.W.R.P.	KW

Readings: Sample readings every 2 min. intervals

Stored: Average hourly values - at one hour intervals

Recorded: a) average daily values - at 24 hour intervals

b) average weekly values - at 168 hour intervals

APPENDIX 'E' - MONITORING INSTRUMENTATION

E.1; Temperature Sensors and Transmitters

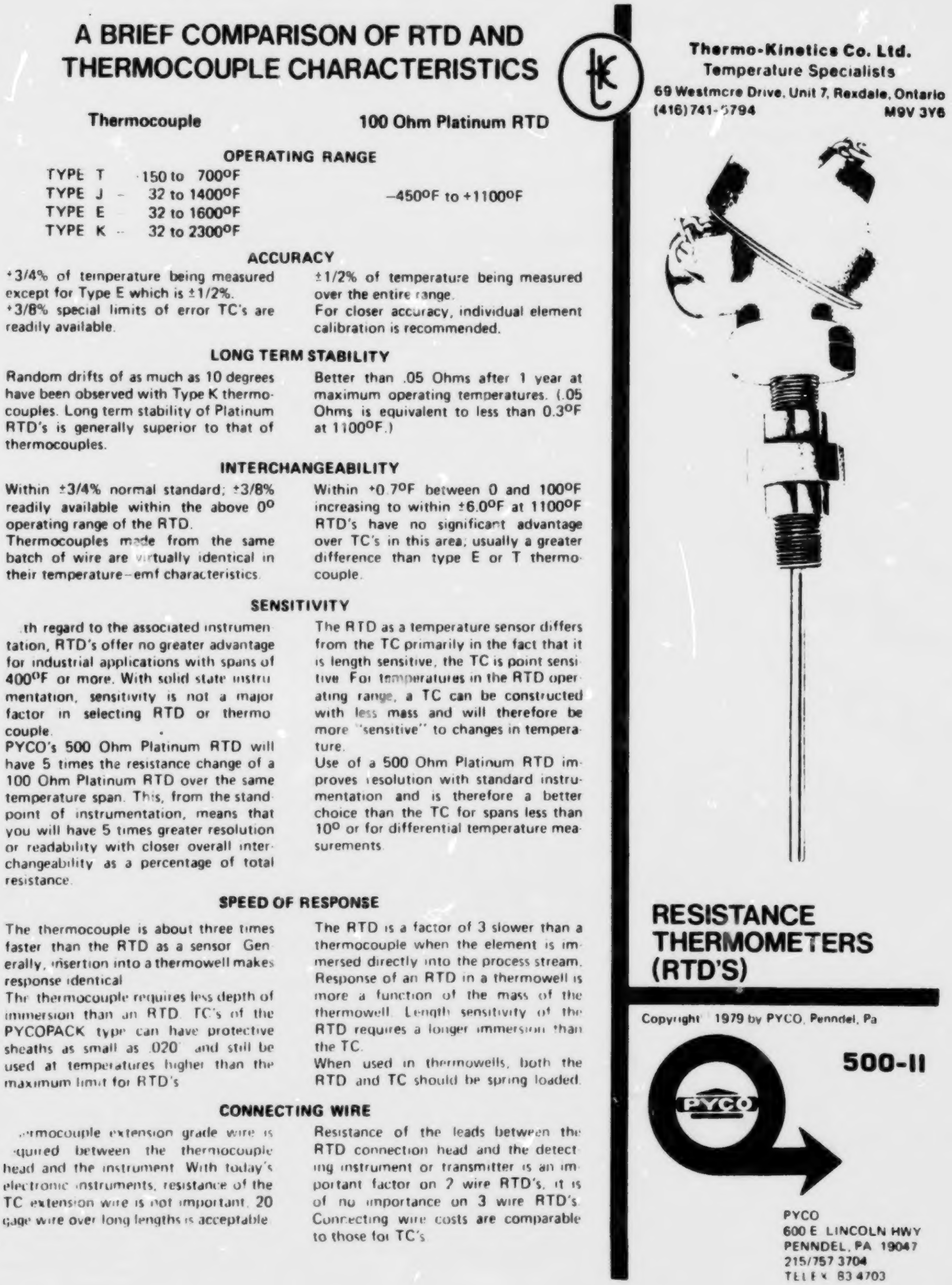
E.2; Pressure Sensors and Transmitters

E.3; Flow Rates Sensors and Transmitters

E.4; Differential Pressure Sensors and Transmitters

E.5; Electrical Loads Sensors and Transmitters

E.6; Data Acquisition and System Control Equipment



A BRIEF COMPARISON OF RTD AND THERMOCOUPLE CHARACTERISTICS

Thermocouple	100 Ohm Platinum RTD
OPERATING RANGE	
TYPE T ·150 to 700°F TYPE J – 32 to 1400°F TYPE E 32 to 1600°F TYPE K – 32 to 2300°F	–450°F to +1100°F
ACCURACY	
+3/4% of temperature being measured except for Type E which is ±1/2%. +3/8% special limits of error TC's are readily available.	±1/2% of temperature being measured over the entire range. For closer accuracy, individual element calibration is recommended.
LONG TERM STABILITY	
Random drifts of as much as 10 degrees have been observed with Type K thermocouples. Long term stability of Platinum RTD's is generally superior to that of thermocouples.	Better than .05 Ohms after 1 year at maximum operating temperatures. (.05 Ohms is equivalent to less than 0.3°F at 1100°F.)
INTERCHANGEABILITY	
Within ±3/4% normal standard; ±3/8% readily available within the above 0° operating range of the RTD. Thermocouples made from the same batch of wire are virtually identical in their temperature–emf characteristics.	Within +0.7°F between 0 and 100°F increasing to within ±6.0°F at 1100°F RTD's have no significant advantage over TC's in this area; usually a greater difference than type E or T thermocouple.
SENSITIVITY	
th regard to the associated instrumentation, RTD's offer no greater advantage for industrial applications with spans of 400°F or more. With solid state instrumentation, sensitivity is not a major factor in selecting RTD or thermocouple. PYCO's 500 Ohm Platinum RTD will have 5 times the resistance change of a 100 Ohm Platinum RTD over the same temperature span. This, from the standpoint of instrumentation, means that you will have 5 times greater resolution or readability with closer overall interchangeability as a percentage of total resistance.	The RTD as a temperature sensor differs from the TC primarily in the fact that it is length sensitive, the TC is point sensitive. For temperatures in the RTD operating range, a TC can be constructed with less mass and will therefore be more "sensitive" to changes in temperature. Use of a 500 Ohm Platinum RTD improves resolution with standard instrumentation and is therefore a better choice than the TC for spans less than 10° or for differential temperature measurements.
SPEED OF RESPONSE	
The thermocouple is about three times faster than the RTD as a sensor. Generally, insertion into a thermowell makes response identical. The thermocouple requires less depth of immersion than an RTD. TC's of the PYCOPACK type can have protective sheaths as small as .020" and still be used at temperatures higher than the maximum limit for RTD's.	The RTD is a factor of 3 slower than a thermocouple when the element is immersed directly into the process stream. Response of an RTD in a thermowell is more a function of the mass of the thermowell. Length sensitivity of the RTD requires a longer immersion than the TC. When used in thermowells, both the RTD and TC should be spring loaded.
CONNECTING WIRE	
rmocouple extension grade wire is quired between the thermocouple head and the instrument. With today's electronic instruments, resistance of the TC extension wire is not important. 20 gage wire over long lengths is acceptable.	Resistance of the leads between the RTD connection head and the detecting instrument or transmitter is an important factor on 2 wire RTD's, it is of no importance on 3 wire RTD's. Connecting wire costs are comparable to those for TC's.

Thermo-Kinetics Co. Ltd.
Temperature Specialists
69 Westmore Drive, Unit 7, Rexdale, Ontario
(416) 741-5794 M9V 3Y6

RESISTANCE THERMOMETERS (RTD'S)

Copyright 1979 by PYCO, Penndel, Pa

500-II

PYCO

PYCO
600 E. LINCOLN HWY
PENNDEL, PA 19047
215/757 3704
TELEX 83 4703

Fastip RTD's

TYPICAL APPLICATIONS

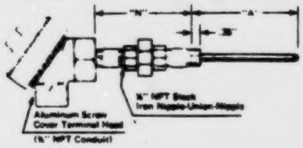
Any resistance thermometer application where fast response is required in the temperature range BELOW 480°F (250°C).

BASIC DESIGN FEATURES

All elements in the FASTIP series have the sensor imbedded in a copper tip which fits into a 0.250" or 0.215" diameter stainless steel sheath.

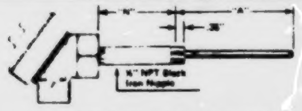
Containment of the entire length sensitive portion of the sensor within a sealed tip significantly improves the speed of response while protecting the sensor from damage due to vibration and environmental factors such as moisture, oil, etc.

The 0.215" O.D. elements are designed to replace EDISON elements having the same diameter.


"N"
"A"
.25"
Aluminum Screw Cover Terminal Head
(¾" NPT Conduit)
½" NPT Black Iron Nipple-Union-Nipple

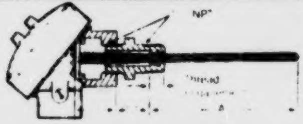
THE DRAWING ABOVE ILLUSTRATES "N-U-N" HARDWARE

22-2007 Fastip RTD Assembly
–OR–
22-4015 Spring Loaded Assembly



THE DRAWING ABOVE ILLUSTRATES NIPPLE HARDWARE

22-2006 Fastip RTD Assembly
–OR–
22-4018 Spring Loaded Assembly



THE DRAWING ABOVE ILLUSTRATES THE SPRING LOADED "O"-RING SEAL FASTIP RTD ASSEMBLY

Part numbers 22-3046 and 22-3051

For those installations where a terminal head will not fit but spring loading with an ("O" Ring) oil seal is needed you should try PYCO's #22-0018 ITEM-"A-B". The 22-0018 uses the same 01 thru 16 ITEM table as 22-3046 Fastip RTD assemblies.

22-7000 SERIES FASTIP ELEMENTS

PYCO Part Number	O.D.	Form
22-7006-ITEM-"L"-"B"	0.250	Single
22-7008-ITEM-"L"-"B"	0.250	Duplex
22-7009-ITEM-"L"-"B"	0.215	Single
22-7020-ITEM-"L"-"B"	0.215	Duplex

Item	Calibration	R100°C/R0°C	Type
01	Copper 10 ohms @ 25°C	1.427	2 Wire
02	Copper 10 ohms @ 25°C	1.427	3 Wire
03	Nickel 120 ohms @ 0°C	1.672	2 Wire
04	Nickel 120 ohms @ 0°C	1.672	3 Wire
05	Platinum 100 ohms @ 0°C	1.385	2 Wire
06	Platinum 100 ohms @ 0°C	1.385	3 Wire
07	Platinum 100 ohms @ 0°C	1.392	2 Wire
08	Platinum 100 ohms @ 0°C	1.392	3 Wire

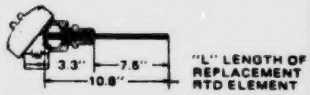
22-2000 NON SPRING LOADED ASSEMBLIES

PYCO Part Number	OD	Hardware
22-2006-ITEM-"N"-"A"	0.250"	½" NPT Nipple
22-2007-ITEM-"N"-"A"	0.250"	½" NPT N-U-N

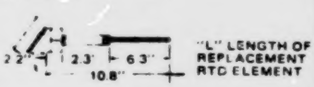
These assemblies use the same item table as their 22-7006 and 22-7008 (above) replacement elements.

HOW TO ORDER

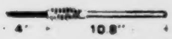
22-3046-03-7.5 identifies an "O" Ring seal assembly with an 0.250" O.D. element.



22-4018-03-2.3-6.3 identifies an assembly with a 3" nipple ("N" = 2.3")

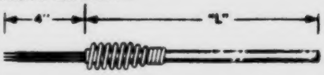


22-6012-02-10.8 identifies the replacement element for either of the above



PLEASE NOTE that the ASSEMBLY Item Number is NOT the same as the replacement ELEMENT Item Number

22-6000 SERIES SPRING-LOADED FASTIP ELEMENTS



PYCO Part Number	O.D.	Form
22-6012-ITEM-"L"	0.250"	Single
22-6013-ITEM-"L"	0.250"	Duplex
22-6019-ITEM-"L"	0.215"	Single
22-6020-ITEM-"L"	0.215"	Duplex

Item	Calibration	R100°C/R0°C	Type
01	Nickel 120 ohms @ 0°C	1.672	2 Wire
02	Nickel 120 ohms @ 0°C	1.672	3 Wire
03	Copper 10 ohms @ 25°C	1.427	2 Wire
04	Copper 10 ohms @ 25°C	1.427	3 Wire
05	Platinum 100 ohms @ 0°C	1.385	2 Wire
06	Platinum 100 ohms @ 0°C	1.385	3 Wire
07	Platinum 100 ohms @ 0°C	1.392	2 Wire
08	Platinum 100 ohms @ 0°C	1.392	3 Wire

FASTIP SPRING-LOADED ASSEMBLIES

Assemblies with nipple or nipple-union-nipple hardware, generally used with thermowells use the 0.250" diameter, spring-loaded element. Assemblies with the ½" x ½" NPT "O"-ring fitting (which seals against 500 psig at 500°F) use both the 0.250" and 0.215" O.D. spring-loaded elements.

PYCO Part Number	O.D.	Hardware
22-4015-ITEM-"N"-"A"	0.250"	N-U-N
22-4018-ITEM-"N"-"A"	0.250	Nipple
22-3046-ITEM-"A"	0.250	"0"-ring
22-3051-ITEM-"A"	0.215	"0"-ring

Item	Calibration	Type	Form
01	120 NI 1.672	2 Wire	Single
02	120 NI 1.672	2 Wire	Duplex
03	120 NI 1.672	3 Wire	Single
04	120 NI 1.672	3 Wire	Duplex
05	10 CU 1.427	2 Wire	Single
06	10 CU 1.427	2 Wire	Duplex
07	10 CU 1.427	3 Wire	Single
08	10 CU 1.427	3 Wire	Duplex
09	100 PT 1.385	2 Wire	Single
10	100 PT 1.385	2 Wire	Duplex
11	100 PT 1.385	3 Wire	Single
12	100 PT 1.385	3 Wire	Duplex
13	100 PT 1.392	2 Wire	Single
14	100 PT 1.392	2 Wire	Duplex
15	100 PT 1.392	3 Wire	Single
16	100 PT 1.392	3 Wire	Duplex

Vibration Resistant High Reliability Spring Loaded RTD's

BASIC 22-6030 DESIGN FEATURES

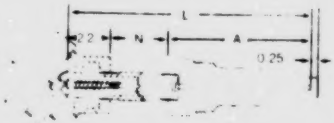
This series offers 100 ohm PLATINUM elements in both single and duplex FORM and 200 and 500 ohm platinum elements in single FORM

All elements in the 22-6030 series have a sheath diameter of 0.250" with an integrally mounted terminal block and loading spring

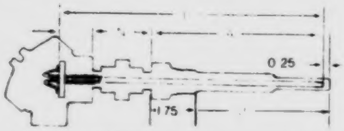
Platinum calibration conforms to DIN 43760, i.e., $R_{100°C}/R_{0°C}$ = 1.385. Resistance sensors built to this DIN standard offer characteristics better suited to rugged industrial applications that involve temperature cycling and vibration.

NUCLEAR HIGHLITE

22-4019 and 22-4030 RTD Assemblies (using the 22-6030 elements) were tested and qualify for use in nuclear power generating stations. Qualification testing includes elevated temperature, background and accident level radiation, vibration endurance, seismic and LOCA simulation tests in accordance with IEEE 323-1974, 344-1975, 382-1972, 383-1974 and MIL-STD-167-1.
Thermowell assemblies comply with ASME BP and V Code Section III and, upon request, are analyzed in accordance with PTC 19.3.



The 22-4019 pictured above shows how to dimension the 22-6030 element's "L" length by adding "N"+"A"+2.2 inches.



The above 22-4030 (Nipple-Union-Nipple) silhouette relates the 22-6030 element length to a typical threaded thermowell's "U" dimension.

ELEMENT AND ASSEMBLY ITEMIZATION

The following table lists the items identifying CALIBRATION, TYPE, and FORM for the 22-6030 elements and 22-4019 or 22-4030 assemblies. "100 PT 1.385" defines the calibration as PLATINUM, 100 ohms at 0°C, with $R_{100°C}/R_{0°C}$ = 1.385. Ohmic tolerance at 0°C, ± 0.1ohm

Item	Calibration	Type	Form
01	100 PT 1.385	2-Wire	Single
02	100 PT 1.385	3-Wire	Single
03	100 PT 1.385	2-Wire	Duplex
04	100 PT 1.385	3-Wire	Duplex
05	500 PT 1.385	2-Wire	Single
06	500 PT 1.385	3-Wire	Single
07	200 PT 1.385	2-Wire	Single
08	200 PT 1.385	3-Wire	Single

HOW TO ORDER

22-4030-04-2.7-7.5 identifies a N-U-N (nipple-union-nipple) type assembly

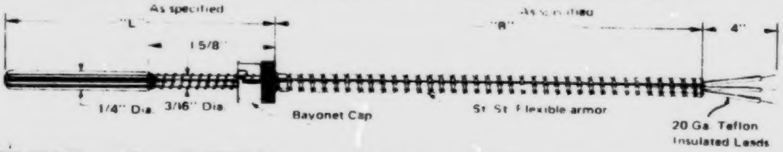
04 = CALIBRATION, 100 PT 1.385; TYPE, 3-wire; FORM, duplex

"N" = 2.7" and "A" = 7.5"

22-6030-04-12.4 specifies the replacement element
12.4 = "N" (2.7") + "A" (7.5") + 2.2"

BAYONET TYPE RTD ASSEMBLY: Spring loaded, bayonet fitting for use in injection molding machines, electric motors, pipe, etc. This RTD provides firm contact with bottom of cavity.

22-5001-HI TEMP
(to 1100°F/600°C)
22-5010-FASTIP
(to 480°F/250°C)



22-5001-02-6-24 specifies a HI TEMP Bayonet assembly: 100 ohm, 3 wire, single sensor with "L" = 6" and "B" = 24". 22-5010-02-6-24 specifies the equivalent FASTIP bayonet assembly.

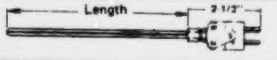
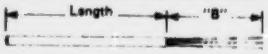
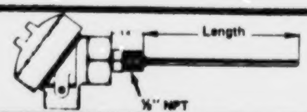
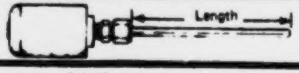
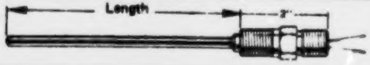
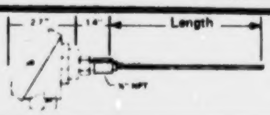
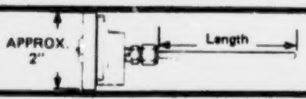
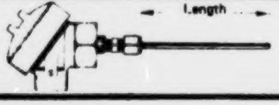
RTD's with standard options:

for use to 600°C (1100°F)
22-1010-item-Length-Option

Item	Calibration	Type	Form
01	Platinum 100 ohms 1.385	2-Wire	Single
02	Platinum 100 ohms 1.385	3-Wire	Single
03	Platinum 100 ohms 1.385	2-Wire	Duplex
04	Platinum 100 ohms 1.385	3-Wire	Duplex
05	Platinum 500 ohms 1.385	2-Wire	Single
06	Platinum 500 ohms 1.385	3-Wire	Single
07	Platinum 200 ohms 1.385	2-Wire	Single
08	Platinum 200 ohms 1.385	3-Wire	Single

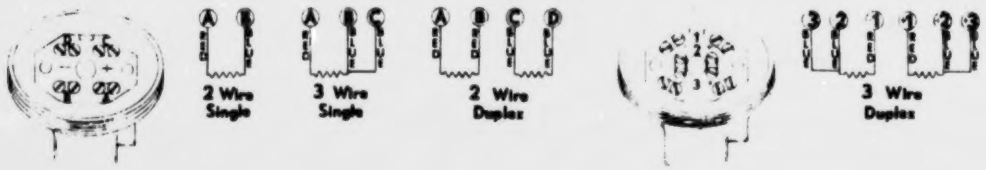
for use to 250°C (480°F)
22-7006-ITEM-Length-Option (Single)
22-7008-ITEM-Length-Option (Duplex)

Item	Calibration	Type
01	Copper 10 ohms @ 25°C 1 427	2 Wire
02	Copper 10 ohms @ 25°C 1 427	3 Wire
03	Nickel 120 ohms @ 0°C 1 672	2 Wire
04	Nickel 120 ohms @ 0°C 1 672	3 Wire
05	Platinum 100 ohms @ 0°C 1 385	2 Wire
06	Platinum 100 ohms @ 0°C 1 385	3 Wire
07	Platinum 100 ohms @ 0°C 1 392	2 Wire
08	Platinum 100 ohms @ 0°C 1 392	3 Wire

ILLUSTRATION OF OPTION	OPTION:	DESCRIPTION OF OPTION:
	A*	QUICK CONNECT MALE PLUG (400°F)
	G*	HIGH TEMPERATURE (1000°F) PLUG
	B	22-1010 RTD's HAVE 22 GAGE NICKEL LEADS WITH FIBERGLASS INSULATION. 22-7006 AND 22-7008 RTD's HAVE 22 AND 24 GAGE TEFLON INSULATED COPPER LEADS.
	C	EXPLOSION-PROOF ALUMINUM SCREW COVER TERMINAL HEAD WITH BLOCK. (¾"NPT CONDUIT THREAD)
	E*	MINIATURE ALUMINUM SCREW CAP TERMINAL HEAD (1.25" OD, APPROX. 2" LONG)
	F	½"x½" NPT CARBON STEEL MOUNTING FITTING WITH 4" LEADS. THIS IS THE REPLACEMENT ELEMENT FOR OPTIONS "C" AND "H".
	H	TWIST LOCK ALUMINUM TERMINAL HEAD WITH BLOCK (½" NPT CONDUIT THREAD)
	K*	MINIATURE WEATHERPROOF PLASTIC (400°F) TERMINAL HEAD (¼" NPT CONDUIT THREAD). (HI-TEMP. 800°F HEAD IS ALSO AVAILABLE)
	L	EXPLOSION-PROOF ALUMINUM SCREW COVER TERMINAL HEAD AND BLOCK IS MOUNTED TO ELEMENT WITH A BRASS COMPRESSION FITTING. (¾" NPT CONDUIT THREAD).

*NOT AVAILABLE ON 3-WIRE DUPLEX ELEMENTS

RTD WIRING CONNECTIONS



Brochure "A Brief Comparison of RTD and Thermocouple Characteristics," reprinted by permission. Copyright 1979 by PYCO, Penndel, Pa.

ITT
BARTON

PRODUCT BULLETIN 392-7

Model 392 Electronic Temperature Transmitter

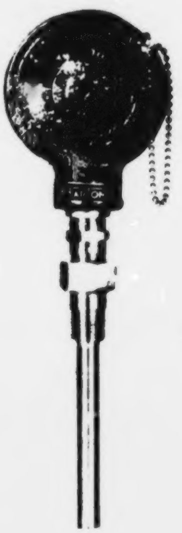
PRODUCT DESCRIPTION

The Barton Model 392 Temperature Transmitter is a close-coupled electronic instrument designed for the measurement of temperature and transmission of the resultant signal to a wide range of electronic control and readout equipment.

It finds application in virtually any process application where temperature is critical to the process.

The electronic components in the Model 392 are compact, solid-state units with outstanding long-term stability and life. The electronic system measures resistance changes as a function of temperature, as monitored by a platinum resistance temperature sensor. The electrical output signal, which is precisely proportional to temperature variations, delivers a 4-20 or optional 10-50 mA signal. Power supplies are available in either signal or multi-channel configurations.

The Model 392 is contained in an explosion-proof conduiet enclosure, certified for Class 1, Group C & D, Division 1 service. The temperature sensor is integrally mounted to the enclosure containing the electronic circuitry. permitting close-coupled mounting of the transmitter at the point of measurement.



FEATURES

- Long-Term Stability
- Outstanding Ambient Temperature Stability
- Insensitive to Normal Shock and Vibration
- Excellent Repeatability
- Superior Zero Stability
- Solid-State Electronics
- Two-Wire Signal Transmission
- Non-Interacting Zero and Span Control

TEMPERATURE RANGE

The Model 392 covers any 50° or larger span between -100° and 900°F.

TEMPERATURE SENSOR

The platinum resistance element is housed in a thin-walled 316 stainless steel sheath. Thermowells are available, and immersion length should be specified when ordering.

© Copyright 1986, ITT Corporation

SPECIFICATIONS

Output	4-20 mA (10-50 mA Optional)
Power Requirements	12 to 35 Vdc or (22 to 80 Vdc Option)
Load Range	0-2900 Ohms (4-20 mA at 80V) 0-1160 Ohms (10-50 mA at 80V)
Load Effect	±0.025% of full range per 100 Ohms (4-20 mA) ±0.06% of full range per 100 Ohms (10-50 mA)
Power Supply Effect	±0.025% of full range for ±1V power supply change (4-20 mA) ±0.06% of full range for ±1V power supply change (10-50 mA)
Temperature Range	-100° F to +900° F

Note: For process media above 300° F, the conduit housing with the transmitter electronics should be separated from the temperature sensor and installed at a distance to insure an ambient temperature for the electronics between -40° F and +160° F. The use of a customer supplied standard connection head at the sensor is recommended to provide termination points.

Maximum Span	1000° F
Minimum Span	50° F
Transmitter Accuracy Incl. Platinum Probe	±0.25% of span
Repeatability	±0.05% of span
Process Connection	½" NPT Standard (Other connections on special order.)
Zero Control	±5% of calibrated range
Span Control	±5% of calibrated range
Operating Temperature Limits (Electronics)	-40° F to +160° F
Ambient Temperature Effect (Electronics)	Zero ±1%/100° F Span ±1%/100° F
Thermowell	304 S.S. ½" NPT (Standard) ¾" NPT (Optional)

The desired output is obtained with any supply voltage from 12 Vdc to 35 Vdc (22 Vdc to 80 Vdc optional), depending on load resistance. 12V (22V) is the minimum sustaining voltage required at the transmitter terminals.

4 to 20 mA output is obtainable with a power supply voltage exceeding the 12 Vdc (22 Vdc optional) minimum by at least 2V for each 100 Ohms load and transmission line resistance, to a maximum of 35V (80V optional).

10 to 50 mA output is obtainable with a power supply voltage exceeding the 35 Vdc (22 Vdc optional) minimum by at least 5V for each 100 Ohms load and transmission line resistance, to a maximum of 35V (80V optional).

ORDERING INFORMATION

When ordering, please specify:

1. Calibrated temperature range (° F):
   (Minimum temperature: -100° F, maximum temperature: +900° F)
2. Thermowell material and NPT thread size
3. Immersion length
4. Process connection

The ITT Barton standard warranty is available for inspection upon request.

YOUR LOCAL REPRESENTATIVE

ITT Barton Instruments Company
900 S. Turnbull Canyon Road
City of Industry, CA 91749-1882
Tele. (818) 961-2547 Telex: 67-7475

CF 10M Litho in U.S.A.

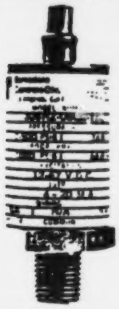
ITT BARTON

ITT Barton Product Bulletin 392-7, "Model 392 Electronic Temperature Transmitter," reprinted by permission. Copyright 1986, ITT Corporation.

Transamerica Delaval **305**

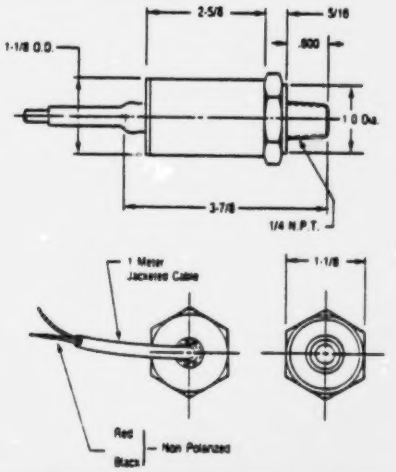
TRANSAMERICA DELAVAL INC. • BARKSDALE CONTROLS DIVISION • 3211 Fruitland Ave., P.O. Box [illegible] • Los Angeles, CA 90058 • (213) 589-6181

Series 305 Pressure Transducer 4-20 mA Output



The Barksdale 305 Series Pressure Transducers provide a 4-20 mA output. There are 11 models with pressure ranges from 0 to 10,000 psi. This 2-wire transducer is interchangeable with a wide range of existing transmitters.

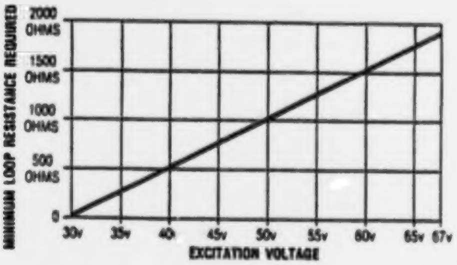
INSTALLATION OUTLINE



Code	Pressure Range	Ordering Number
	(PSIG)	Unshielded Jacketed Cable
03	0—50	305H2—03CG—11—L
04	0—100	305H2—04CG—11—L
07	0—300	305H2—07CG—11—L
08	0—500	305H2—08CG—11—L
09	0—750	305H2—09CG—11—L
10	0—1000	305H2—10CG—11—L
12	0—2000	305H2—12CG—11—L
14	0—4000	305H2—14CG—11—L
15	0—5000	305H2—15CG—11—L
17	0—7500	305H2—17CG—11—L
18	0—10,000	305H2—18CG—11—L
Approximate Weight: 4.5 ounces		

SPECIFICATIONS:

Excitation:	12v to 67v DC (With appropriate series resistance)
Output:	4-20 mA
Proof Pressure:	2 x full scale or 15,000 psi (whichever is less)
Minimum Output Load Resistance:	(See chart)



PERFORMANCE

Accuracy:	±0.5% full scale at 75°F (Linearity, hysteresis, and repeatability)
Zero Balance:	±2.0% of full scale at 75°F
Span Tolerance:	±1.0% of full scale at 75°F
Compensated Temp. Range:	+30° to +130° F standard
Thermal Zero Effect:	±.02%/°F standard
Thermal Span Effect:	±.02%/°F standard
Operable Temperature Range:	0°F to 160°F
Resolution:	Infinite
Pressure Range:	0 to 10,000 PSIG

CONSTRUCTION

Body Diaphragm Material:	17-4 ph stainless steel
Pressure Port:	¼-18 NPT standard
Electrical Connections:	See installation outline
Pressure Cavity Volume:	.055 cubic inches maximum

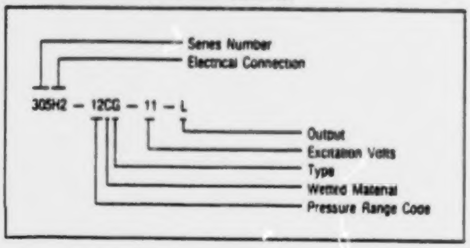
MODIFICATIONS AVAILABLE

Available where quantity warrants. Consult factory for prices and delivery.

- Higher/Lower compensated and operating temperature ranges
- Other pressure ranges
- Other pressure port configurations
- Other body construction materials
- Excitation voltages
- Outputs
- Connectors
- Free Leads
- Shielded Jacketed Cable (H3)*

*To specify, insert H3 for the electrical symbol in Part Number. Example: 305H3-03CG-11-L

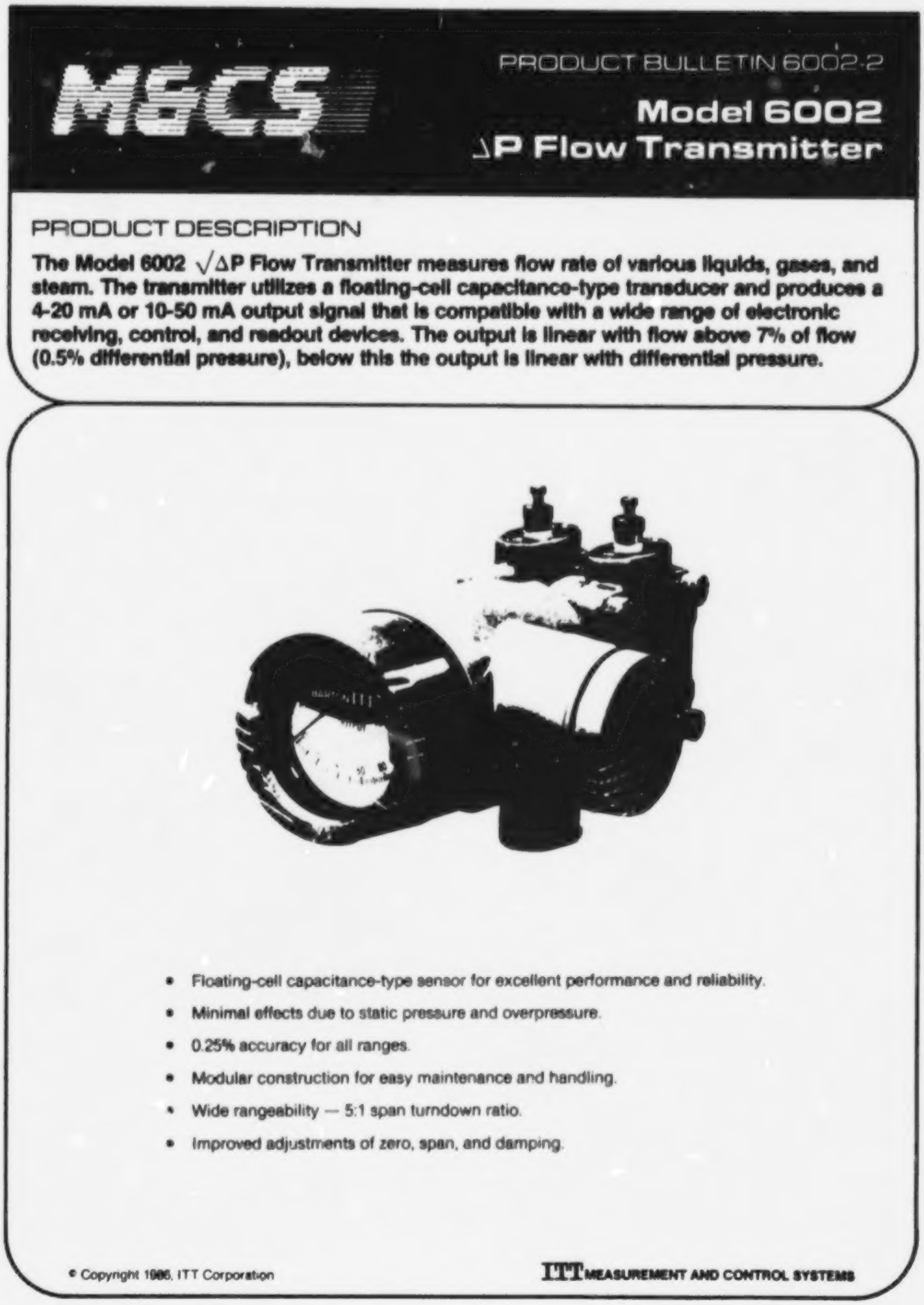
TRANSDUCER PART NUMBER CODING:



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Printed in U.S.A.

E.3; Flow Rates Sensors and Transmitters



M&CS

PRODUCT BULLETIN 6002-2

Model 6002
ΔP Flow Transmitter

PRODUCT DESCRIPTION

The Model 6002 $\sqrt{\Delta P}$ Flow Transmitter measures flow rate of various liquids, gases, and steam. The transmitter utilizes a floating-cell capacitance-type transducer and produces a 4-20 mA or 10-50 mA output signal that is compatible with a wide range of electronic receiving, control, and readout devices. The output is linear with flow above 7% of flow (0.5% differential pressure), below this the output is linear with differential pressure.

- Floating-cell capacitance-type sensor for excellent performance and reliability.
- Minimal effects due to static pressure and overpressure.
- 0.25% accuracy for all ranges.
- Modular construction for easy maintenance and handling.
- Wide rangeability — 5:1 span turndown ratio.
- Improved adjustments of zero, span, and damping.

© Copyright 1986, ITT Corporation

ITT MEASUREMENT AND CONTROL SYSTEMS

FIELD-PROVEN TECHNOLOGY

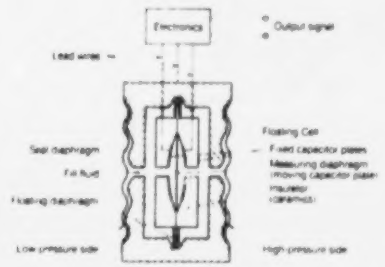
The Model 6002 Flow Transmitter uses the field-proven technology of variable capacitance measurement to convert mechanical motion created by pressure changes or differences into a useful electrical signal. The result is excellent performance in the most difficult of applications.

Differential process pressure is applied across the seal diaphragms of the sensing unit as shown in the figure below. The process pressure is transferred through a non-compressible fill fluid to displace the measuring diaphragm. The measuring diaphragm acts as the common capacitor plate between two fixed capacitor plates. The displacement increases the distance from the common plate to one of the fixed plates and decreases the distance from the common plate to the second plate, resulting in a change of capacitance that is a precise function of the differential pressure. The unit electronically takes the square root of differential pressure to give an output that is linear with flow. A simple conversion, however, provides operation that is linear with differential pressure so that the Model 6002 can provide you with either flow or differential pressure measurement.

THE FLOATING CELL DESIGN

The effects of high static pressure, overpressure conditions, and temperature changes are minimized by a unique feature of Series 6000 transmitters, the floating cell design. This construction avoids errors due to stresses and torques on the process flanges. The actual sensing cell "floats" in the fill fluid and is further isolated from adverse external effects such as vibration and shock by the floating diaphragm.

FLOATING CELL



MODULAR CONSTRUCTION FOR EASY MAINTENANCE

Compact modular construction is the key to easy maintenance in the Model 6002. In fact, you can perform most maintenance procedures with a minimum of time and tools. The same goes for servicing. High reliability makes servicing infrequent, but when servicing is necessary, modular construction makes it easy.

The transmitter design essentially combines a detecting unit with an electronics unit. The detecting unit consists of process flanges enclosing the sensing cell, which is in itself a completely enclosed electron-beam welded assembly. The electronics unit has an interchangeable amplifier and a base printed circuit board which consists of passive components for temperature compensation. The electronics enclosure is a weatherproof NEMA-type enclosure and has two separate chambers: one for the terminal wire connections, another for the electronics. The terminal connections are sealed off from the electronics so that the electronics circuitry is not exposed to the atmosphere when the terminal box cover is removed for wiring hook-up.

AN INNOVATION IN ADJUSTMENTS

The Model 6002 Transmitter introduces a course/fine adjustment design that improves reliability by avoiding the use of a single potentiometer for the entire adjustment of each variable. This design uses a connection bar so that flow (square root) to linear, coarse span, and damping adjustments are easy and reliable, yet require only a screwdriver.

With the Model 6002 you can elevate and suppress the zero from -20 to +20% of upper range limit. The zero control is external, and all other controls are internal to guard against indiscriminate adjustments which may upset the calibration.

5:1 TURNDOWN

With a 5:1 span turndown ratio, the Model 6002 offers a wide range of adjustability. The wide rangeability gives you a highly versatile transmitter, so you can keep fewer on hand and still meet most of your needs.

SPECIAL FEATURES

- It's increasingly important to protect your transmitters against RFI/EMI effects. All Series 6000 Transmitters have standard built-in RFI filters to assure reliable operation where walkie-talkies or other sources of radio frequency energy may be present.

ITT MEASUREMENT AND CONTROL SYSTEMS

- All Series 6000 Transmitters also have the available option of an integral meter. By simply plugging the meter into its socket, you can convert a "blind" unit into a locally indicating unit in seconds and still retain the FM explosion-proof rating.
- When you need damping to stabilize the output response in applications where the measured flow pulsates, the Model 6002 gives you four choices of electronic damping, from no damping to a time constant of 5 seconds at maximum span.
- Other available options:

  An integral solid-state lightning arrester for protection against transients caused by lightning or other sources.

  A universal mounting bracket for mounting either on 2" pipe (vertical or horizontal) or on a panel.

  Process connection adapters. The standard connection si ¼" NPT on 2⅛" centers or, with the adapters, ½" NPT on adjustable 2", 2⅛", or 2¼" centers (up to 2000 psi SWP).

  2800 psi SWP.

TOP PERFORMER IN TOUGH CONDITIONS

The Model 6002 gives you top performance from as low as 0-0.8" w.c. to 0-1250" w.c. In those tough applications where a corrosive fluid is incompatible with carbon steel or 316 SS, you can instead choose Hastelloy C,* Monel, or Tantalum. FM explosion-proof approval is standard for hazardous locations, Class I, Division 1, Groups B, C, and D. CSA approval is available as an option.

In tough conditions — low ranges, high static pressure, overpressure, corrosive process fluids, hazardous locations — ITT M&CS Series 6000 Transmitters are instruments made to measure.

OPERATIONAL SPECIFICATIONS

SERVICE	Liquid, gas, or vapor
RANGES	1) 0-.8/4" wc 2) 0-2/10" wc 3) 0-10/50" wc 4) 0-50/250" wc 5) 0-250/1250" wc
OUTPUTS	4-20 mA DC (limited to 30 mA) 10-50 mA DC (limited to 75 mA)
ACCURACY (includes linearity, hysteresis, & repeatability)	±0.25% for all ranges from 20 to 100% flow. ±0.5% from 7 to 20% flow. Linear with D.P. below 7%
POWER SUPPLY	(Unit protected against reverse polarity.)
4-20 mA DC	12-45 Vdc (with no load)
10-50 mA DC	25-70 Vdc (with no load)
LOAD LIMITATIONS	See figure next page
INDICATION	(Optional) Meter with 2½" linear scale Accuracy: 1.5% of Full Scale
SPAN CONTROL	Continuously adjustable between 100% and 20% of maximum span (5:1 turndown)
ZERO CONTROL	Continuously adjustable between -20% and +20% of upper range limit.
TEMPERATURE LIMIT:	
Electronics Unit, Operating	-20° to +180° F -40° to +140° F (Low Temperature Option)
Sensing Unit, Operating	-22° to +212° F (Silicone Oil Fill) +14° to +140° F (Fluorolube Fill) -40° to +140° F (Low Temperature Option)
Storage	-40° to +212° F
OVERPRESSURE LIMIT	Up to SWP
STATIC PRESSURE LIMIT	Up to SWP
HUMIDITY LIMIT	0-100% relative humidity
VOLUMETRIC DISPLACEMENT	Range 1-4 (.01 cubic inches) Range 5 (.02 cubic inches)
TURN-ON TIME	2 seconds (with no damping)
ADJUSTABLE DAMPING	4 steps selectable: without damping, and time constant of 2, 3, and 5 seconds
LIGHTNING ARRESTER	Built-in solid-state arrester (optional). Power Supply voltage must be less than 27 Vdc.

*Hastelloy is a Cabot Corporation trademark.
Monel is an International Nickel Company trademark.

ITT MEASUREMENT AND CONTROL SYSTEMS

PERFORMANCE SPECIFICATIONS *

DEAD BAND:	None
STEP RESPONSE: (Time Constant)	Range Code 1 0.8 seconds " 2 0.3 " " 3 0.3 " " 4 0.1 " " 5 0.05 "
STABILITY:	±0.25% of upper range limit for 6 months.
TEMPERATURE EFFECT: Total Effect (Including Zero and Span at maximum span from 20 to 100% of flow range)	Ranges 1, 2, & 5: ±1.4%/100°F Ranges 3 & 4: ±0.75%/100°F
OVERRANGE EFFECT: (Zero shift to full over-pressure limit at 20 to 100% of flow range.)	

Range Codes		Overrange Effect
1	150 SWP	±0.75% URL
2	500 SWP	±0.88% URL
3, 4, 5	2000 SWP	±1.05% URL
4, 5	6000 SWP	±1.5% URL
3, 4, 5	900 SWP	±0.75% URL

STATIC PRESSURE EFFECT: (% of differential pressure)

SWP (PSI)	Zero Error % of URL	Span Error (% of Cal Span)
150	±0.2%	+0.15% ±0.05% @ 150 PSI
500	±0.23%	+0.15% ±0.15% @ 500 PSI
2000	±0.14%	+0.25% ±0.1%/1000 PSI
6000	±0.14%	+0.25% ±0.1%/1000 PSI
900	±0.2%	+0.25% ±0.1%/900 PSI

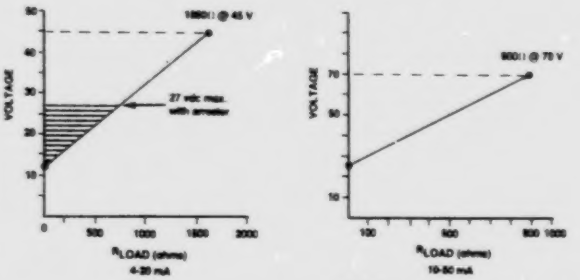
VIBRATION EFFECT:	±0.05% upper range limit per g, from 10 to 200 Hz in any axis.
POWER SUPPLY EFFECT:	Less than 0.01% of output span per volt.
LOAD EFFECT:	None, other than change in power supplied to transmitter.
MOUNTING POSITION EFFECT:	
Zero Error:	2" H_2O for 90° Inclination perpendicular to diaphragm (maximum).
Span Error:	Negligible
RFI EFFECT:	Built-in RFI Filter effective from 27 to 500 MHz.

PHYSICAL SPECIFICATIONS

MATERIALS OF CONSTRUCTION:	
Process Flanges & Vent/Drain Valves:	Zinc/chromate Carbon Steel, 316 SS, Hastelloy C lining, or Monel lining
Seal Diaphragm:	316 SS, Hastelloy C-276, Monel, or Tantalum
Wetted O-Ring:	Viton** (Standard), Teflon with special materials
Fill Fluid:	Silicone Oil (or Fluorolube Fill† for special applications)
BOLTS:	Zinc plated Carbon Steel, or 17-4 PH SS
ELECTRONICS HOUSING:	Low-copper aluminum
PAINT:	Epoxy-polyurethane
ENVIRONMENTAL PROTECTION:	Electronics housing is weather-proof, dust-proof, and waterproof as defined in NEMA 4.
HAZARDOUS LOCATIONS:	Explosion-proof approved by Factory Mutual Research for Class I, Division 1, Groups B, C, and D; Class II, Division 1, Groups E, F, and G; and Class III, Division 1.
PROCESS CONNECTIONS:	¼-18 NPT on 2⅛" center ½-14 NPT on 2", 2⅛", or 2¼" centers with Flange adapters (ordered separately).
ELECTRICAL CONNECTIONS:	½-14 NPT (Screw terminals in terminal box.)
CHECK TERMINALS:	Diode shunted
WEIGHT:	16 lbs. without options (26.5 lbs. for 6000 psi SWP)

*Silicone Oil Fill and 316 SS isolating diaphragms.
**Viton is a DuPont trademark.
†Fluorolube is a Hooker Chemical Company trademark.

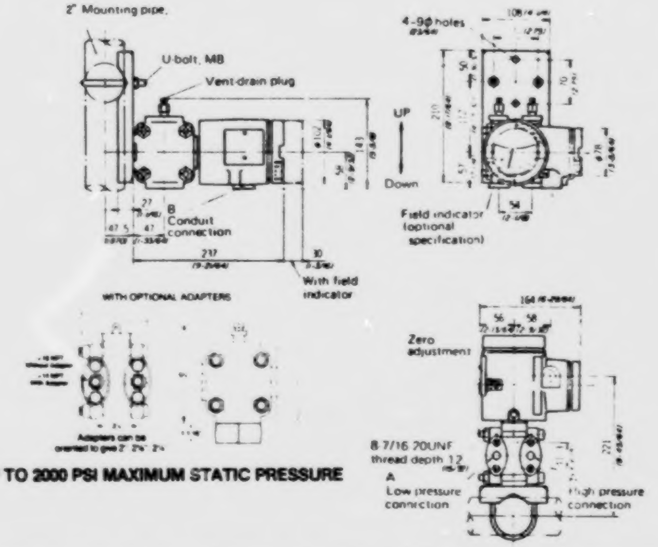
POWER SUPPLY VOLTAGE VS MAXIMUM LOAD RESISTANCE



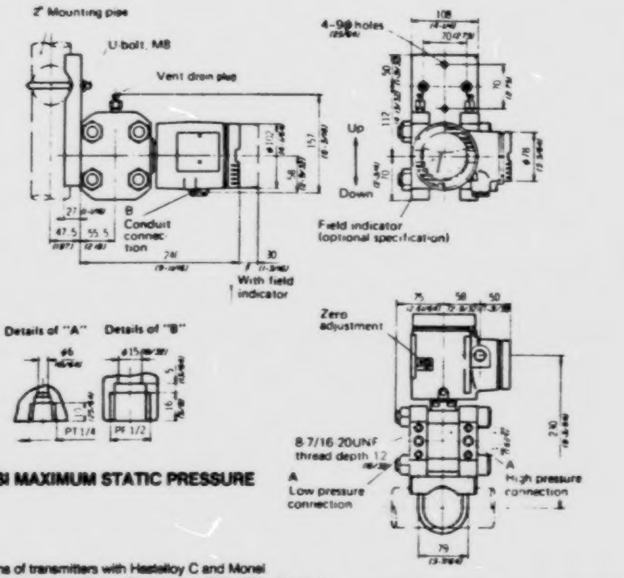
ITT MEASUREMENT AND CONTROL SYSTEMS

OUTLINE DIMENSION DRAWINGS

DIMENSIONS IN MILLIMETERS (AND INCHES)


2" Mounting pipe.
U-bolt, M8
Vent-drain plug
4-9φ holes
108
70
210
112
57
UP
Down
φ102
143
54
φ78
27
47.5
47
B
Conduit connection
237
30
With field indicator
Field indicator (optional specification)
54
WITH OPTIONAL ADAPTERS
Adapters can be oriented to give 2", 2⅛", 2¼"
164
56
58
Zero adjustment
221
8-7/16-20UNF thread depth 12
A
Low pressure connection
High pressure connection

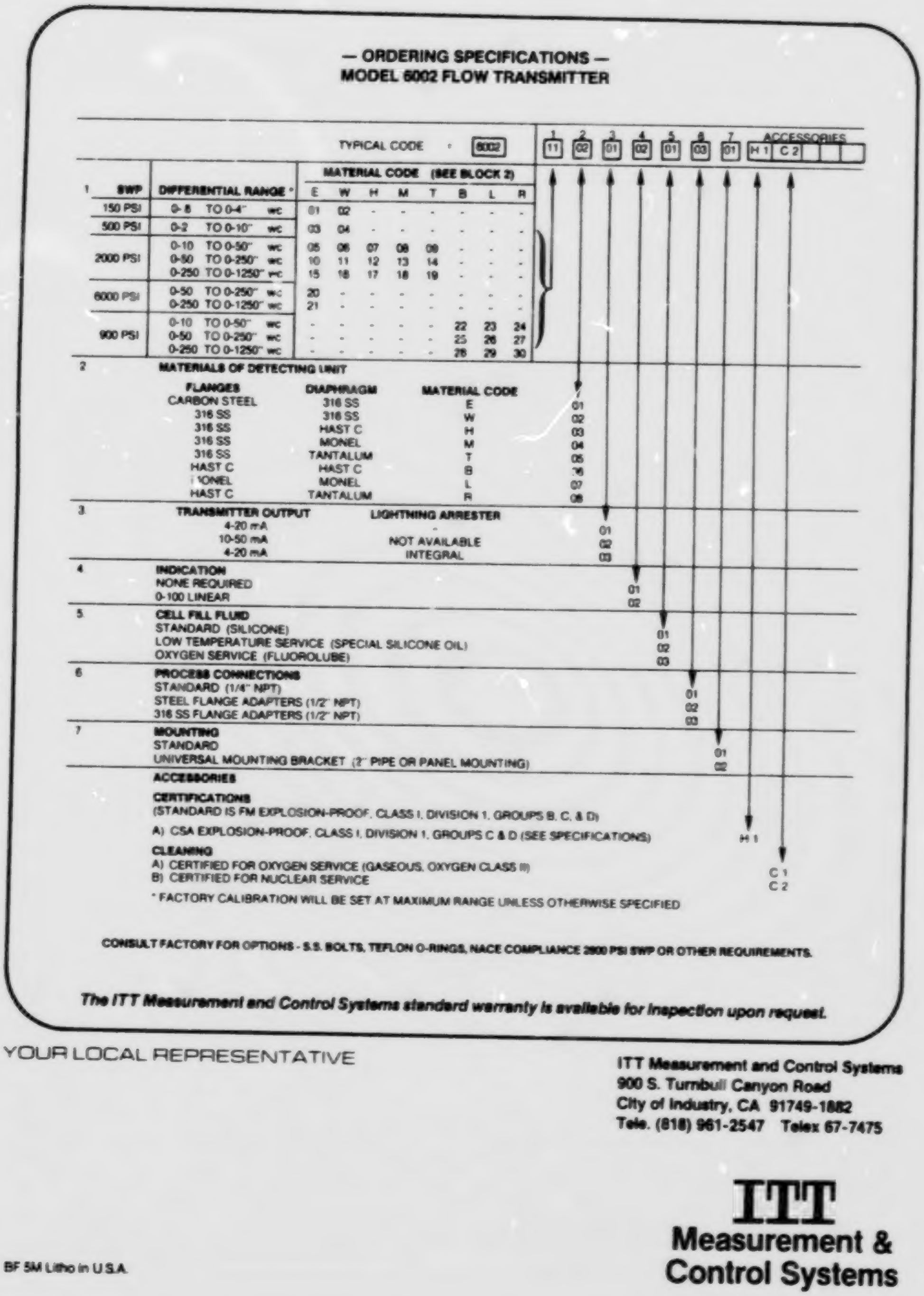
UP TO 2000 PSI MAXIMUM STATIC PRESSURE


2" Mounting pipe
U-bolt, M8
Vent drain plug
4-9φ holes
108
70
50
112
70
Up
Down
φ102
157
58
φ78
27
47.5
55.5
B
Conduit connection
241
30
With field indicator
Field indicator (optional specification)
Details of "A"
Details of "B"
φ6
φ15
5
16
PT 1/4
PF 1/2
75
58
50
Zero adjustment
240
8-7/16-20UNF thread depth 12
A
Low pressure connection
A
High pressure connection
79

6000 PSI MAXIMUM STATIC PRESSURE

NOTE:
For dimensions of transmitters with Hastelloy C and Monel lined cover flanges, request Barton Drawing No. 6002-15011, Sheet 4.

ITT MEASUREMENT AND CONTROL SYSTEMS



— ORDERING SPECIFICATIONS —
MODEL 6002 FLOW TRANSMITTER

TYPICAL CODE : 6002 | 1: 11 | 2: 02 | 3: 01 | 4: 02 | 5: 01 | 6: 03 | 7: 01 | ACCESSORIES: H 1, C 2

1 SWP	DIFFERENTIAL RANGE *	MATERIAL CODE (SEE BLOCK 2) E	W	H	M	T	B	L	R
150 PSI	0-.8 TO 0-4" wc	01	02	-	-	-	-	-	-
500 PSI	0-2 TO 0-10" wc	03	04	-	-	-	-	-	-
2000 PSI	0-10 TO 0-50" wc	05	06	07	08	09	-	-	-
	0-50 TO 0-250" wc	10	11	12	13	14	-	-	-
	0-250 TO 0-1250" wc	15	16	17	18	19	-	-	-
6000 PSI	0-50 TO 0-250" wc	20	-	-	-	-	-	-	-
	0-250 TO 0-1250" wc	21	-	-	-	-	-	-	-
900 PSI	0-10 TO 0-50" wc	-	-	-	-	-	22	23	24
	0-50 TO 0-250" wc	-	-	-	-	-	25	26	27
	0-250 TO 0-1250" wc	-	-	-	-	-	28	29	30

2 **MATERIALS OF DETECTING UNIT**

FLANGES	DIAPHRAGM	MATERIAL CODE	
CARBON STEEL	316 SS	E	01
316 SS	316 SS	W	02
316 SS	HAST C	H	03
316 SS	MONEL	M	04
316 SS	TANTALUM	T	05
HAST C	HAST C	B	06
MONEL	MONEL	L	07
HAST C	TANTALUM	R	08

3

TRANSMITTER OUTPUT	LIGHTNING ARRESTER	
4-20 mA	-	01
10-50 mA	NOT AVAILABLE	02
4-20 mA	INTEGRAL	03

4 **INDICATION**

NONE REQUIRED	01
0-100 LINEAR	02

5 **CELL FILL FLUID**

STANDARD (SILICONE)	01
LOW TEMPERATURE SERVICE (SPECIAL SILICONE OIL)	02
OXYGEN SERVICE (FLUOROLUBE)	03

6 **PROCESS CONNECTIONS**

STANDARD (1/4" NPT)	01
STEEL FLANGE ADAPTERS (1/2" NPT)	02
316 SS FLANGE ADAPTERS (1/2" NPT)	03

7 **MOUNTING**

STANDARD	01
UNIVERSAL MOUNTING BRACKET (2" PIPE OR PANEL MOUNTING)	02

ACCESSORIES

CERTIFICATIONS
(STANDARD IS FM EXPLOSION-PROOF, CLASS I, DIVISION 1, GROUPS B, C, & D)

A) CSA EXPLOSION-PROOF, CLASS I, DIVISION 1, GROUPS C & D (SEE SPECIFICATIONS)	H 1

CLEANING

A) CERTIFIED FOR OXYGEN SERVICE (GASEOUS, OXYGEN CLASS III)	C 1
B) CERTIFIED FOR NUCLEAR SERVICE	C 2

* FACTORY CALIBRATION WILL BE SET AT MAXIMUM RANGE UNLESS OTHERWISE SPECIFIED

CONSULT FACTORY FOR OPTIONS - S.S. BOLTS, TEFLON O-RINGS, NACE COMPLIANCE 2800 PSI SWP OR OTHER REQUIREMENTS.

The ITT Measurement and Control Systems standard warranty is available for inspection upon request.

YOUR LOCAL REPRESENTATIVE

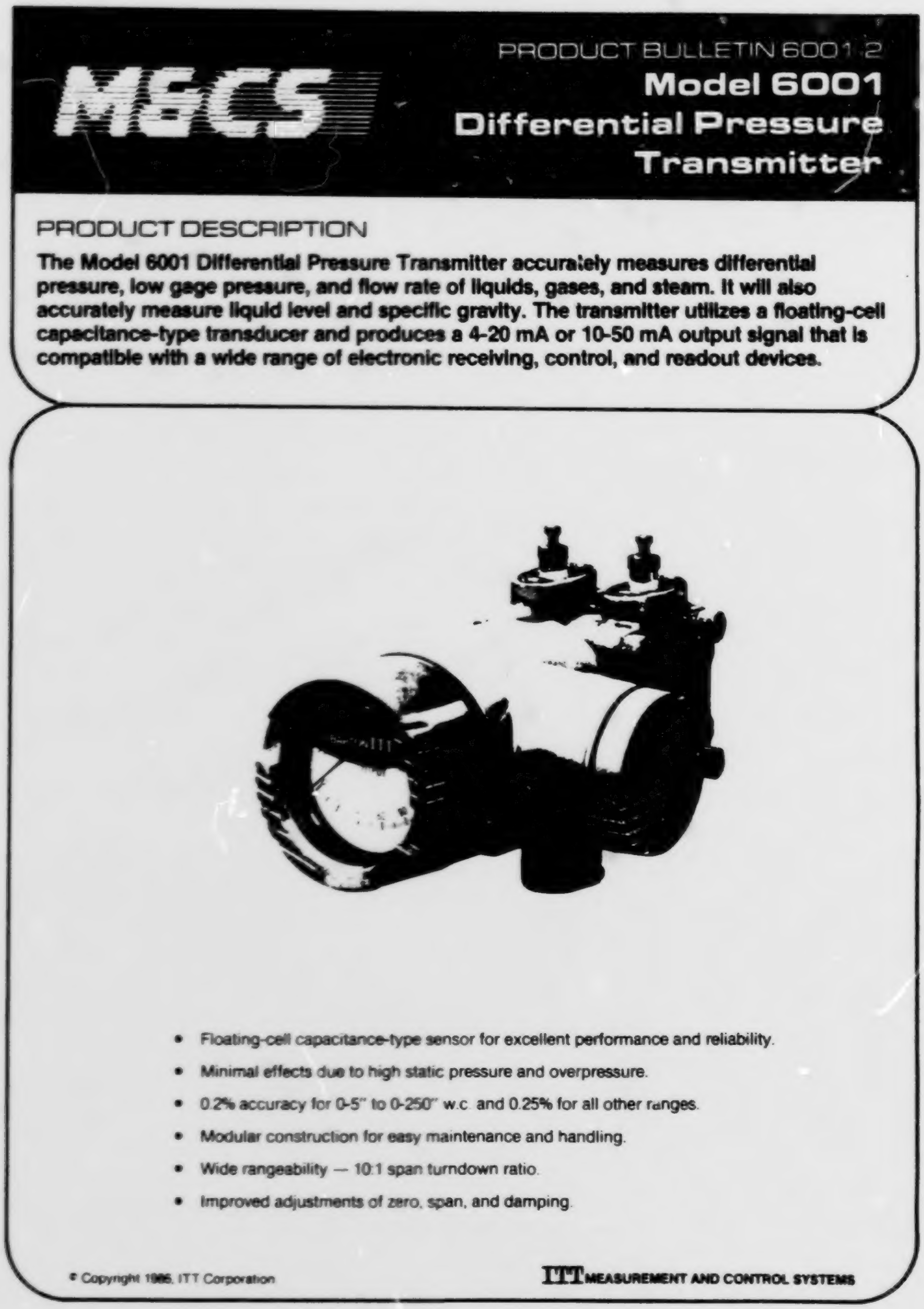
ITT Measurement and Control Systems
900 S. Turnbull Canyon Road
City of Industry, CA 91749-1882
Tele. (818) 961-2547 Telex 67-7475

ITT
Measurement &
Control Systems

BF 5M Litho in U.S.A.

M&CS Product Bulletin 6002-2, "Model 6002 √ΔP Flow Transmitter," reprinted by permission. Copyright 1986, ITT Corporation

E.4; Differential Pressure Sensors and Transmitters



PRODUCT BULLETIN 6001-2

MSCS

Model 6001 Differential Pressure Transmitter

PRODUCT DESCRIPTION

The Model 6001 Differential Pressure Transmitter accurately measures differential pressure, low gage pressure, and flow rate of liquids, gases, and steam. It will also accurately measure liquid level and specific gravity. The transmitter utilizes a floating-cell capacitance-type transducer and produces a 4-20 mA or 10-50 mA output signal that is compatible with a wide range of electronic receiving, control, and readout devices.

- Floating-cell capacitance-type sensor for excellent performance and reliability.
- Minimal effects due to high static pressure and overpressure.
- 0.2% accuracy for 0-5" to 0-250" w.c. and 0.25% for all other ranges.
- Modular construction for easy maintenance and handling.
- Wide rangeability — 10:1 span turndown ratio.
- Improved adjustments of zero, span, and damping.

© Copyright 1986, ITT Corporation

ITT MEASUREMENT AND CONTROL SYSTEMS

FIELD-PROVEN TECHNOLOGY

The Model 6001 Differential Pressure Transmitter uses the field-proven technology of variable capacitance measurement to convert mechanical motion created by pressure changes or differences into a useful electrical signal. The result is excellent performance in the most difficult of applications.

Differential process pressure is applied across the seal diaphragms of the sensing unit as shown in the figure below. The process pressure is transferred through a non-compressible fill fluid to slightly displace the measuring diaphragm. The measuring diaphragm acts as the common capacitor plate between two fixed capacitor plates. The displacement increases the distance from the common plate to one of the fixed plates and decreases the distance from the common plate to the second plate, resulting in a change of capacitance that is a precise function of the differential pressure. The change in capacitance is detected by electronic circuitry and is then converted into an output current signal.

THE FLOATING CELL DESIGN

The effects of high static pressure, overpressure conditions, and temperature changes are significantly minimized by a unique feature of Series 6000 Transmitters, the floating cell design. This construction avoids errors due to stresses and torques on the process flanges. The actual sensing cell "floats" in the fill fluid and is further isolated from adverse external effects such as vibration and shock by the floating diaphragm.

MODULAR CONSTRUCTION FOR EASY MAINTENANCE

Compact modular construction is the key to easy maintenance in the Model 6001. In fact, you can perform most maintenance procedures with a minimum of time and tools. The same goes for servicing. High reliability makes servicing infrequent, modular construction makes it easy.

The transmitter design essentially combines a detecting unit with an electronics unit. The detecting unit consists of process flanges enclosing the sensing cell, which is in itself a completely enclosed electron-beam welded assembly. The electronics unit has an interchangeable amplifier, and a base printed circuit board which consists of passive components for temperature compensation. The electronics enclosure is a weatherproof NEMA-type enclosure and has two separate chambers: one for the wire terminal connections, another for the electronics. The terminal connections are sealed off from the electronics so that the electronics circuitry is not exposed to atmosphere when the terminal box cover is removed for wiring hook-up.

AN INNOVATION IN ADJUSTMENTS

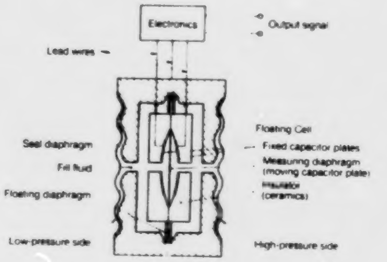
Series 6000 Transmitters introduce a coarse/fine adjustment design that improves reliability by avoiding the use of a single potentiometer for the entire adjustment range of each variable. This design uses a screw-type "jumper-plug" with which coarse zero, coarse span, and damping adjustments are easily and reliably achieved, yet requires only a screwdriver.

With the Model 6001 you can elevate the zero to a maximum of 500% and suppress the zero to a maximum of 900%. The fine zero control is external, while all other controls are internal to guard against indiscriminate adjustments which may upset the calibration.

10:1 TURNDOWN

With a 10:1 span turndown ratio, the Model 6001 offers as wide a range as any transmitter available. Since each transmitter has such a wide rangeability, you can keep fewer on hand and still meet most of your needs. The wide rangeability combines with the zero control to give you great versatility. As a typical example, the 50" w.c. range Model 6001 can easily be calibrated to 45-50" w.c. output (4 mA at 45", 20 mA at 50" w.c.).

FLOATING CELL



ITT MEASUREMENT AND CONTROL SYSTEMS

SPECIAL FEATURES

- It's increasingly important to protect your transmitters against RFI/EMI effects. All Series 6000 Transmitters have standard built-in RFI filters to assure reliable operation where walkie-talkies or other sources of radio frequency energy may be present.

- All Series 6000 Transmitters also have the available option of an integral meter. By simply plugging the meter into its socket, you can convert a "blind" unit into a locally indicating unit in seconds and still retain the FM explosion-proof rating.

- When you need damping to stabilize the output response in applications where the measured pressure oscillates, the Model 6001 gives you four choices of electronic damping, from no damping to a time constant of 3 seconds at maximum span.

- Other available options:

  An integral solid-state lightning arrester for protection against transients caused by lightning or other sources.

  A universal mounting bracket for mounting either on 2" pipe (vertical or horizontal) or on a panel.

  Process connection adapters. The standard connection is ¼" NPT on 2⅛" centers or, with the adapters, ½" NPT on adjustable 2", 2⅛", or 2¼" centers (up to 2000 psi SWP).

  2800 psi SWP.

TOP PERFORMER IN TOUGH CONDITIONS

The Model 6001 gives you top performance from as low as 0-0.4" w.c. to 0-430 psi. In those tough applications where a corrosive fluid is incompatible with carbon steel or 316 SS, you can instead choose Hastelloy C,* Monel, or Tantalum. FM explosion-proof approval is standard for hazardous locations, Class I, Division 1, Groups B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1. FM Intrinsically Safe approval or CSA approvals are also available.

In tough conditions — low ranges, high static pressure, overpressure, corrosive process fluids, hazardous locations — ITT M&CS Series 6000 Transmitters are instruments made to measure.

OPERATIONAL SPECIFICATIONS

SERVICE:	Liquid, gas, or vapor
RANGES:	1) 0-.4/4" wc 2) 0-1/10" wc 3) 0-5/50" wc 4) 0-25/250" wc 5) 0-4.6/46 PSI 6) 0-43/430 PSI
OUTPUTS:	4-20 mA DC (limited to 30 mA) 10-50 mA DC (limited to 75 mA)
ACCURACY (Includes linearity, hysteresis, & repeatability)	±0.20% for ranges 3 & 4 ±0.25% for other ranges
POWER SUPPLY:	(Unit protected against reverse polarity.)
4-20 mA DC:	12-45 Vdc (with no load)
10-50 mA DC:	25-70 Vdc (with no load)
LOAD LIMITATIONS:	See figure next page
INDICATION:	(Optional) Meter with 2¾" linear scale or square root scale Accuracy: 1.5% of Full Scale
SPAN CONTROL:	Continuously adjustable between 100% and 10% of maximum span (10:1 turndown).
ZERO CONTROL:	Continuously adjustable between -50% and +100% of upper range limit. The total calibrated span and zero adjustment can not exceed the upper range limit.
TEMPERATURE LIMIT:	
Electronics Unit, Operating:	-20° to +180°F -40° to +140°F (Low Temperature Option)
Sensing Unit, Operating:	-22° to +212°F (Silicone Oil Fill) +14° to +140°F (Fluorolube Fill) -40° to +140°F (Low Temperature Option)
Storage:	-40° to +212°F
OVERPRESSURE LIMIT:	Up to SWP
STATIC PRESSURE LIMIT:	Up to SWP
HUMIDITY LIMIT:	0-100% relative humidity
VOLUMETRIC DISPLACEMENT	Range 1-4 (.01 cubic inches) Range 5 (.02 cubic inches) Range 6 (.05 cubic inches)
TURN-ON TIME:	2 seconds (with no damping)
ADJUSTABLE DAMPING:	4 steps selectable: without damping, and time constant of 0.2, 1, and 3 seconds at maximum span. (2, 10, and 30 seconds at minimum span).
LIGHTNING ARRESTER:	Built-in solid-state arrester (optional). Power Supply voltage must be less than 27 Vdc.

*Hastelloy is a Cabot Corporation trademark.
Monel is an International Nickel Company trademark.

ITT MEASUREMENT AND CONTROL SYSTEMS

PERFORMANCE SPECIFICATIONS*

DEAD BAND:	None
STEP RESPONSE: (Time Constant)	Range Code 1 0.8 seconds " 2 0.3 " " 3 0.3 " " 4 0.1 " " 5 0.05 " " 6 0.05 "
STABILITY:	±0.25% of upper range limit for 6 months.
TEMPERATURE EFFECT: Total Effect (Including Zero and Span at maximum span)	Ranges 1, 2, & 6: ±1.1%/100°F Ranges 3, 4 & 5: ±1%/100°F
OVERRANGE EFFECT: (Zero shift to full overpressure limit.)	

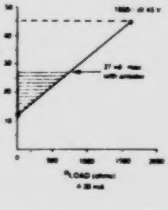
Range Codes		Overrange Effect (% URL)
1	150 SWP	±0.3%
2	500 SWP	±0.35%
3, 4, 5, 6	2000 SWP	±0.35%
4, 5, 6	6000 SWP	±0.6%
3, 4, 5	900 SWP	±0.3%

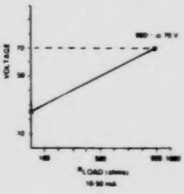
STATIC PRESSURE EFFECT:

SWP (PSI)	Zero Error (% of URL)	Span Error (% of Cal Span)
150	±0.2%	+0.15% ±0.05% @ 150 PSI
500	±0.23%	+0.15% ±0.15% @ 500 PSI
2000	±0.14%	+0.25% ±0.1%/1000 PSI
6000	±0.14%	+0.25% ±0.1%/1000 PSI
900	±0.2%	+0.25% ±0.1% @ 900 PSI

VIBRATION EFFECT:	±0.06% upper range limit per g, 10 to 200 Hz in any axis.
POWER SUPPLY EFFECT:	Less than 0.01% of output span per volt.
LOAD EFFECT:	None, other than change in power supplied to transmitter.
MOUNTING POSITION EFFECT:	
Zero Error:	2" H_2O for 90° Inclination perpendicular to diaphragm (maximum).
Span Error:	Negligible
RFI EFFECT:	Built-in RFI Filter effective from 27 to 500 MHz.

*Silicone Oil Fill and 316 SS isolating diaphragms.
**Viton is a DuPont trademark.
†Fluorolube is a Hooker Chemical Company trademark.





PHYSICAL SPECIFICATIONS

MATERIALS OF CONSTRUCTION:	
Process Flanges & Vent/ Drain Valves:	Zinc/Chromate plated Carbon Steel, 316 SS, Hastelloy C lining, or Monel lining
Seal Diaphragm:	316L SS, Hastelloy C-276, Monel, or Tantalum
Wetted O-Ring:	Viton** (Standard), Teflon with special materials
Fill Fluid:	Silicone Oil (Mineral Oil for 0-430 PSID range) (or Fluorolube Fill † for special applications.)
BOLTS:	Zinc plated Carbon Steel, or 17-4 PH SS
ELECTRONICS HOUSING:	Low-copper aluminum
PAINT:	Epoxy-polyurethane
ENVIRONMENTAL PROTECTION:	Electronics housing is weatherproof, dust-proof, and waterproof as defined in NEMA 4.
HAZARDOUS LOCATIONS:	Explosion-proof approved by Factory Mutual Research for Class I, Division 1, Groups B, C, and D; Class II, Division 1, Groups E, F and G; and Class III, Division 1. FM Intrinsically Safe when used with barrier as shown below and installed as per manual. Consult factory for CSA qualification.
PROCESS CONNECTIONS:	¼-18 NPT on 2⅛" center ½-14 NPT on 2", 2⅛", or 2¼" centers with Flange adapters (ordered separately).
ELECTRICAL CONNECTIONS:	½-14 NPT (Screw terminals in terminal box.)
CHECK TERMINALS:	Diode shunted
WEIGHT:	16 lbs. without options (26.5 lbs. for 6000 psi SWP)

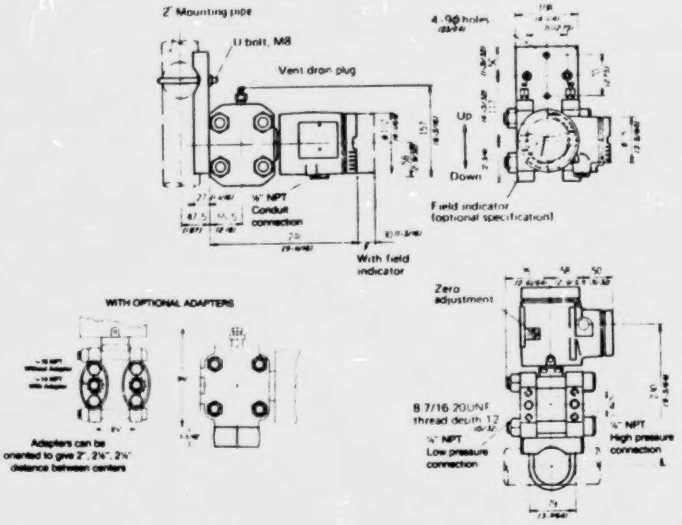
Safety Barrier Manufacturer	Model	FM Approval For Class I, Div. 1, Groups A	B	C	D
Stahl	8901/33-082/000/79 8903/31-315/080/70	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Taylor	1135FF21000 1130FF21000			✓ ✓	✓ ✓
Westinghouse	753B02	✓	✓	✓	✓
Measurement Technology	MTL128- MTL188- *MTL188R+ MTL322	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Honeywell	38545-·····-0110-113-F585 38545-·····-0110-111-F585 38545-·····-0110-112-F585	✓	✓	✓ ✓ ✓	✓ ✓ ✓
Foxboro	2AI-12V-FGB 2AI-13V-FGB 2AS-131-FGB 3A2-12D CS-E/FGB-A 3A2-13D CS-E/FGB-A		✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓

* Not approved for use with indicator
Lightning Arrester not available for intrinsic safety

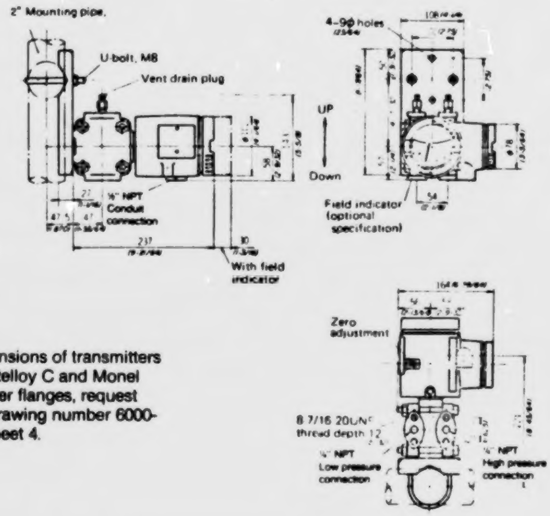
ITT MEASUREMENT AND CONTROL SYSTEMS

OUTLINE DIMENSION DRAWINGS

(DIMENSIONS IN MILLIMETERS (AND INCHES))


2" Mounting pipe
U bolt, M8
Vent drain plug
4-9φ holes
Up
Down
½" NPT
Conduit
connection
Field indicator
(optional specification)
With field
indicator
WITH OPTIONAL ADAPTERS
Adapters can be
oriented to give 2", 2⅛", 2¼"
distance between centers
Zero
adjustment
8 7/16 20UNF
thread depth 12
¼" NPT
Low pressure
connection
¼" NPT
High pressure
connection
151
27
47.5
237
10
58
50
230
79

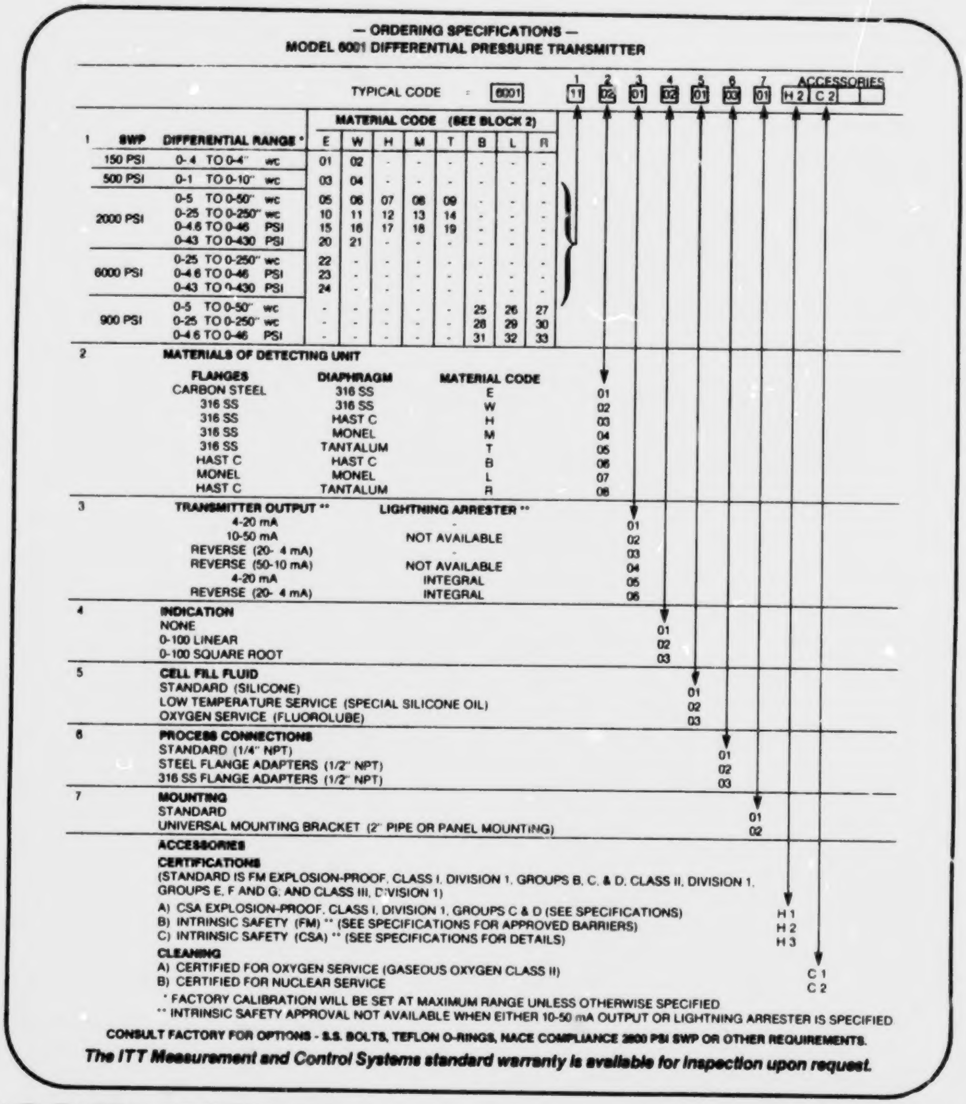
UP TO 2000 PSI MAXIMUM STATIC PRESSURE


2" Mounting pipe.
U-bolt, M8
Vent drain plug
4-9φ holes
108
UP
Down
½" NPT
Conduit
connection
Field indicator
(optional
specification)
54
φ78
27
47.5
47
237
10
With field
indicator
164.6
Zero
adjustment
8 7/16 20UNF
thread depth 12
¼" NPT
Low pressure
connection
¼" NPT
High pressure
connection

NOTE:
For dimensions of transmitters with Hastelloy C and Monel lined cover flanges, request Barton drawing number 6000-15011, sheet 4.

6000 PSI MAXIMUM STATIC PRESSURE

ITT MEASUREMENT AND CONTROL SYSTEMS



— ORDERING SPECIFICATIONS —
MODEL 6001 DIFFERENTIAL PRESSURE TRANSMITTER

TYPICAL CODE	=	6001	1	2	3	4	5	6	7	ACCESSORIES			
			11	02	01	02	01	03	01	H 2	C 2		

1	SWP	DIFFERENTIAL RANGE *	MATERIAL CODE (SEE BLOCK 2)							
			E	W	H	M	T	B	L	R
	150 PSI	0- 4 TO 0-4" wc	01	02	-	-	-	-	-	-
	500 PSI	0-1 TO 0-10" wc	03	04	-	-	-	-	-	-
	2000 PSI	0-5 TO 0-50" wc	05	06	07	08	09	-	-	-
		0-25 TO 0-250" wc	10	11	12	13	14	-	-	-
		0-4.6 TO 0-46 PSI	15	16	17	18	19	-	-	-
		0-43 TO 0-430 PSI	20	21	-	-	-	-	-	-
	6000 PSI	0-25 TO 0-250" wc	22	-	-	-	-	-	-	-
		0-4.6 TO 0-46 PSI	23	-	-	-	-	-	-	-
		0-43 TO 0-430 PSI	24	-	-	-	-	-	-	-
	900 PSI	0-5 TO 0-50" wc	-	-	-	-	-	25	26	27
		0-25 TO 0-250" wc	-	-	-	-	-	28	29	30
		0-4.6 TO 0-46 PSI	-	-	-	-	-	31	32	33

2 **MATERIALS OF DETECTING UNIT**

FLANGES	DIAPHRAGM	MATERIAL CODE	
CARBON STEEL	316 SS	E	01
316 SS	316 SS	W	02
316 SS	HAST C	H	03
316 SS	MONEL	M	04
316 SS	TANTALUM	T	05
HAST C	HAST C	B	06
MONEL	MONEL	L	07
HAST C	TANTALUM	R	08

3 TRANSMITTER OUTPUT **	LIGHTNING ARRESTER **	
4-20 mA	-	01
10-50 mA	NOT AVAILABLE	02
REVERSE (20- 4 mA)	-	03
REVERSE (50-10 mA)	NOT AVAILABLE	04
4-20 mA	INTEGRAL	05
REVERSE (20- 4 mA)	INTEGRAL	06

4 INDICATION	
NONE	01
0-100 LINEAR	02
0-100 SQUARE ROOT	03

5 CELL FILL FLUID	
STANDARD (SILICONE)	01
LOW TEMPERATURE SERVICE (SPECIAL SILICONE OIL)	02
OXYGEN SERVICE (FLUOROLUBE)	03

6 PROCESS CONNECTIONS	
STANDARD (1/4" NPT)	01
STEEL FLANGE ADAPTERS (1/2" NPT)	02
316 SS FLANGE ADAPTERS (1/2" NPT)	03

7 MOUNTING	
STANDARD	01
UNIVERSAL MOUNTING BRACKET (2" PIPE OR PANEL MOUNTING)	02

ACCESSORIES

CERTIFICATIONS

(STANDARD IS FM EXPLOSION-PROOF, CLASS I, DIVISION 1, GROUPS B, C, & D, CLASS II, DIVISION 1, GROUPS E, F AND G, AND CLASS III, DIVISION 1)

A) CSA EXPLOSION-PROOF, CLASS I, DIVISION 1, GROUPS C & D (SEE SPECIFICATIONS)	H 1
B) INTRINSIC SAFETY (FM) ** (SEE SPECIFICATIONS FOR APPROVED BARRIERS)	H 2
C) INTRINSIC SAFETY (CSA) ** (SEE SPECIFICATIONS FOR DETAILS)	H 3

CLEANING

A) CERTIFIED FOR OXYGEN SERVICE (GASEOUS OXYGEN CLASS II)	C 1
B) CERTIFIED FOR NUCLEAR SERVICE	C 2

* FACTORY CALIBRATION WILL BE SET AT MAXIMUM RANGE UNLESS OTHERWISE SPECIFIED

** INTRINSIC SAFETY APPROVAL NOT AVAILABLE WHEN EITHER 10-50 mA OUTPUT OR LIGHTNING ARRESTER IS SPECIFIED

CONSULT FACTORY FOR OPTIONS - S.S. BOLTS, TEFLON O-RINGS, NACE COMPLIANCE 2000 PSI SWP OR OTHER REQUIREMENTS.

The ITT Measurement and Control Systems standard warranty is available for inspection upon request.

YOUR LOCAL REPRESENTATIVE

ITT Measurement and Control Systems
900 S. Turnbull Canyon Road
City of Industry, CA 91749-1882
Tele. (818) 961-2547 Telex 67-7475

ITT
Measurement &
Control Systems

BF 5M Litho in U.S.A.

M&CS Product Bulletin 6001-2, "Model 6001 Differential Pressure Transmitter," reprinted by permission. Copyright 1986, ITT Corporation.

E.5; Electrical Loads Sensors and Transmitters

wodex

AC POWER TRANSDUCERS

WATT • VAR • Q • COMBINED WATT/VAR • COMBINED WATT/Q

FEATURES

- 0.2% OF READING ACCURACY
- LOW TEMPERATURE COEFFICIENT
- VOLTAGE, CURRENT, PROCESS OUTPUTS
- TRANSIENT PROTECTED
- NO ZERO ADJUSTMENT EVER REQUIRED
- ELECTRONIC MULTIPLIERS
- ISOLATED OUTPUTS ON COMBINED UNITS
- LOW BURDENS
- UNEXCEEDED LONG TERM STABILITY
- STANDARDIZED WIRING AND MOUNTING
- ACTIVE PHASE SHIFTERS ARE FREQUENCY INDEPENDENT

Wodex power measurement transducers are high accuracy electronic multiplying devices.

Conservatively rated at 0.2% of READING, the accuracy includes variations in voltage, current, power factor and output load, if within specified ranges.

All units are available in 1, 2, 2½ and 3 element versions either self-powered or powered from an external source.

Var and Q transducers have active phase shifters which are not frequency dependant within ± 10% of design frequency.

Although the zero adjustment has been brought out, it need not ever be readjusted from its initial factory setting.

Surge withstand testing includes a special 5kV test with frequency varying from 50 kHz to 2 MHz. Dielectric breakdown is tested to 2000V RMS 60 Hz for 1 minute.

APPLICATION TABLE

MODEL NUMBER					CONNECTION	RESTRICTIONS	
WATT	VAR	Q	COMBINED WATT/VAR	COMBINED WATT/Q		VOLTAGE	LOAD
W-10	R-10	Q-10	WR-10	WQ-10	1 PHASE	NONE	NONE
W-20	R-20	Q-20	WR-20	WQ-20	3 PHASE 3 WIRE	NONE	NONE
W-25	R-25	Q-25	WR-25	WQ-25	3 PHASE 4 WIRE	BALANCED	NONE
W-30	R-30	Q-30	WR-30	WQ-30	3 PHASE 4 WIRE	NONE	NONE

AC POWER TRANSDUCERS

POTENTIAL TABLE V(ac)

OPTION	NOMINAL INPUT	POTENTIAL RANGE WITH ACCURACY - SELF POWERED	POTENTIAL RANGE WITH ACCURACY - EXTERNAL POWER	MAXIMUM [1] BURDEN AT NOMINAL	POTENTIAL OVERLOAD CONTINUOUS
0	120 V	85 - 150 V	0 - 150 V	0.02 V•A	180 V
1	69 V	50 - 90 V	0 - 90 V	0.02 V•A	100 V
2	240 V	170 - 300 V	0 - 300 V	0.02 V•A	350 V
3	460 V	325 - 575 V	0 - 575 V	0.02 V•A	680 V
4	600 V	425 - 750 V	0 - 750 V	0.02 V•A	900 V

NOTE [1] — Self powered units have a potential burden of less than 3.0 VA on terminals 3 and 4

CURRENT TABLE A(ac)

OPTION	INPUT	OVERRANGE WITH ACCURACY	MAXIMUM BURDEN	OVERLOAD CONTINUOUS	OVERLOAD 10 SEC/HOUR	OVERLOAD 1 SEC/HOUR
0	0 - 5A	10A	0.5 V•A	15A	30A	250A
1	0 - 1A	2.0A	0.5 V•A	3A	6A	100A
2	0 - 2A	4.0A	0.5 V•A	6A	12A	150A
3	0 - 10A	20A	0.5 V•A	30A	50A	300A
4	0 - 25A	35A	0.5 V•A	35A	75A	300A

OUTPUT TABLE

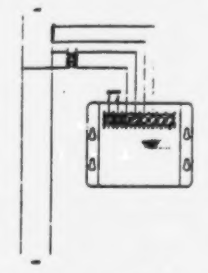
OPTION	RANGE (FULL SCALE)	MAXIMUM LOAD * MINIMUM LOAD	COMPLIANCE VOLTAGE * MAXIMUM CURRENT
0	0 ± 1 mA	10 000 Ohm	± 11 V
1	0 ± 3 mA	3 300 Ohm	± 11 V
2	0 ± 5 mA	2 000 Ohm	± 11 V
3	0 ± 10 mA	1 000 Ohm	± 11 V
4	4 - 20 mA	750 Ohm	15 V
5	0 ± 100 mV	* 20 Ohm	* 5 mA
6	0 ± 1 V	* 200 Ohm	* 5 mA
7	0 ± 5 V	* 1 000 Ohm	* 5 mA
8	0 ± 10 V	* 2 000 Ohm	* 5 mA
9	1 - 5V	* 1 000 Ohm	* 5 mA

FULL SCALE CALIBRATION (WATT/VAR/Q PER ELEMENT [2])

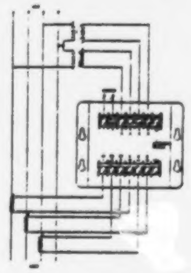
CURRENT POTENTIAL	0 - 5 A	0 - 1 A	0 - 2 A	0 - 10 A	0 - 25A
120V	500	100	200	1 000	2 500
69V	325	65	130	650	1 625
240V	1 000	200	400	2 000	5 000
460V	2 000	400	800	4 000	10 000
600V	2 500	500	1 000	5 000	12 500

NOTE [2] — 2½ element trandsucers are calibrated as 3 element

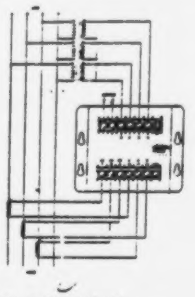
CONNECTION DIAGRAMS AND PHYSICAL DIMENSIONS



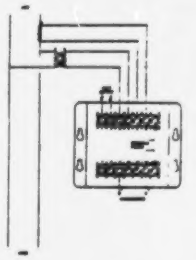
W/R/Q-10 1 ELEMENT



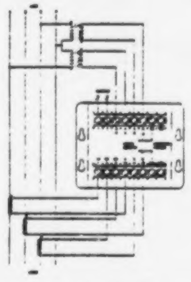
W/R/Q-25 2½ ELEMENT



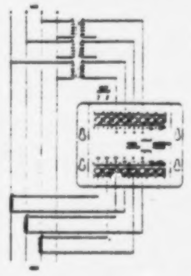
W/R/Q-30 3 ELEMENT



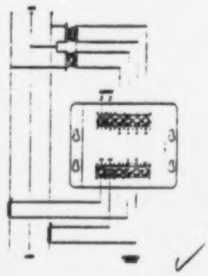
WR/WQ-10 1 ELEMENT



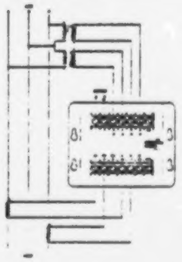
WR/WQ-25 2½ ELEMENT



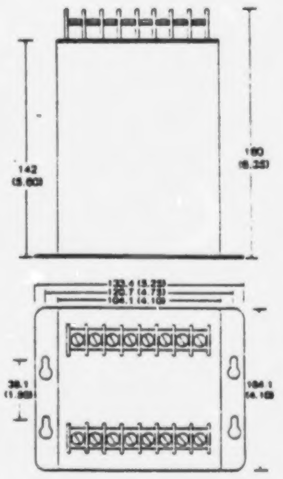
WR/WQ-30 3 ELEMENT



W/R/Q-20 2 ELEMENT

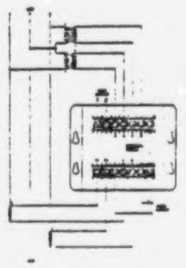


W/R/Q-25 2½ ELEMENT
CONNECTED AS 2 ELEMENT

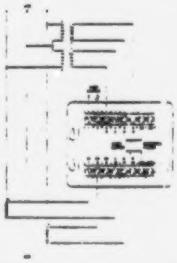


DIMENSIONS ARE IN MM (INCHES). FOR EASE OF MOUNTING 4 KEYHOLES ARE PROVIDED WITH 4.75 MM (3/16) MINIMUM DIMENSION. TERMINALS ARE 7/16 SPACING WITH 6-32 BINDING HEAD MACHINE SCREWS. THE CASE IS EXTRUDED ALUMINUM WITH INTEGRAL CARD GUIDES. ALL ELECTRONICS ARE AFFIXED TO THE TOP PLATE, AND CAN BE EASILY WITHDRAWN

PHYSICAL DIMENSIONS



WR/WQ-20 2 ELEMENT

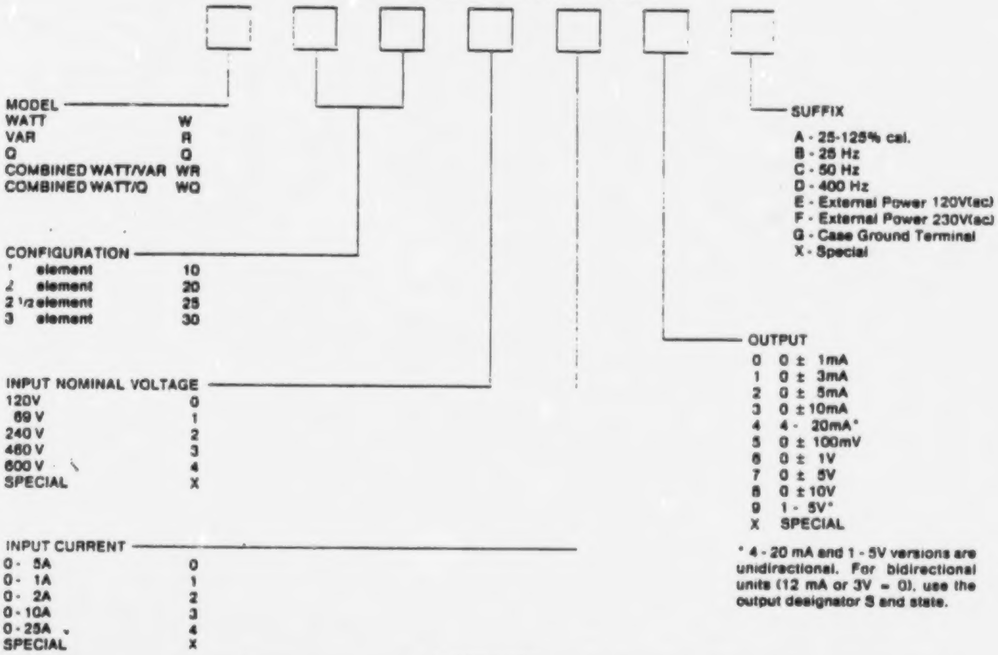


WR/WQ-25 2½ ELEMENT
CONNECTED AS 2 ELEMENT

GENERAL SPECIFICATiONS

ACCURACY AT 25°C ± 2°C: WATT	$\frac{0.19\%\ \text{READING}}{\text{Cos}\ \theta}$ ± 0.01% Full Scale
VAR	$\frac{0.19\%\ \text{READING}}{\text{Sin}\ \theta}$ ± 0.01% Full Scale
Q	$\frac{0.19\%\ \text{READING}}{\text{Cos}\ (\theta - 60°)}$ ± 0.01% Full Scale
TEMPERATURE RANGE:	- 20°C to + 70°C
TEMPERATURE COEFFICIENT:	0.[illegible]06%/°C typical
OPERATING HUMIDITY:	0 - 95% non condensing
OUTPUT RIPPLE (PEAK):	Less than 0.5% of Full Scale
POWER FACTOR RANGE:	WATT or VAR - any Q - 0.866 lead to 0 lag
DIELECTRIC TEST:	2000 VRMS for 1 minute
OPERATING FREQUENCY:	NOMINAL ± 10%
SURGE WITHSTAND:	ANSI-C37.90a-1974 (IEEE 472) BEAMA 219 SPECIAL 5kV
RESPONSE TIME TO:	90% less than 200 ms 99% less than 400 ms
CALIBRATION ADJUSTMENT:	± 10% standard
ZERO ADJUSTMENT:	± 2% Standard

ORDERING INFORMATION



MODEL	
WATT	W
VAR	R
Q	Q
COMBINED WATT/VAR	WR
COMBINED WATT/Q	WQ

CONFIGURATION	
1 element	10
2 element	20
2 1/2 element	25
3 element	30

INPUT NOMINAL VOLTAGE	
120V	0
69 V	1
240 V	2
480 V	3
600 V	4
SPECIAL	X

INPUT CURRENT	
0 - 5A	0
0 - 1A	1
0 - 2A	2
0 - 10A	3
0 - 25A	4
SPECIAL	X

OUTPUT	
0	0 ± 1mA
1	0 ± 3mA
2	0 ± 5mA
3	0 ± 10mA
4	4 - 20mA*
5	0 ± 100mV
6	0 ± 1V
7	0 ± 5V
8	0 ± 10V
9	1 - 5V*
X	SPECIAL

* 4 - 20 mA and 1 - 5V versions are unidirectional. For bidirectional units (12 mA or 3V = 0), use the output designator S and state.

SUFFIX

- A - 25-125% cal.
- B - 25 Hz
- C - 50 Hz
- D - 400 Hz
- E - External Power 120V(ac)
- F - External Power 230V(ac)
- G - Case Ground Terminal
- X - Special

WARRANTY

Wodex Technology Incorporated warrants the products sold hereunder as free from defect of material or workmanship and as conforming to specifications, when used under normal conditions of service and maintained by competent personnel.

At its sole discretion, Wodex Technology Incorporated agrees to repair, or replace, or refund the purchase price of such products that are found to be defective in material or workmanship or which fail to conform to specifications if written notice is received by Wodex Technology Incorporated within 18 months from the date of shipment ex works.

Wodex Technology Incorporated assumes no liability, expressed or implied beyond the obligation to repair, replace, or refund the purchase price of the defective material.

REPRESENTED BY:

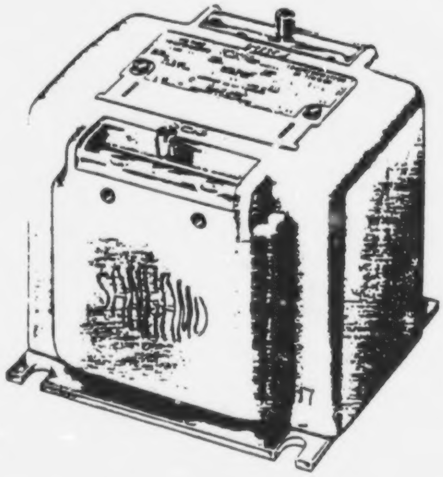
Wodex Technology Incorporated
.1 - 57 Glen Cameron Road,
Thornhill, Ontario L3T 1P3
(416) 889-4750
Telex: 06-964507

PRINTED IN CANADA

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

INSTRUMENT TRANSFORMERS • *BULLETIN 801* • *FEBRUARY 1973*
(Supersedes bulletin - TR-23)

ME-FORM 6 600 VOLT CLASS INDOOR/OUTDOOR VOLTAGE TRANSFORMER



APPLICATION

The Sangamo Type ME—Form 6 Voltage Transformer is designed for indoor and outdoor metering applications for low voltage 60 HZ circuits up to 600 volts.

RATINGS

Nominal Voltage Ratings		Ratio
Primary	Secondary	
120	120	1:1
240	120	2:1
288	120	2.4:1
300	120	2.5:1
360	120	3:1
480	120	4:1
600	120	5:1

CONSTRUCTION

The Type ME—Form 6 Voltage Transformer construction provides a small, lightweight, compact design.

Epoxy Moulded

The Type ME—Form 6 Voltage Transformer is vacuum impregnated and moulded with epoxy resin. This tough flexible epoxy resin, selected for its high dielectric and mechanical strength makes this compact design possible.

Core

The Type ME—Form 6 Voltage Transformer is of a shell type construction, using two wound cores of liberal cross-section.

It is made from a high grade of grain oriented electrical steel.

By rigidly controlled conditions these cores are manufactured and heat-treated to produce the best magnetic properties obtainable.

Terminals

The primary and secondary coils are terminated at the top of the transformer on easy-to-use terminals, moulded into the epoxy. These terminals are permanently marked with the letters "PRIM" and "SEC", moulded into the transformer.

Connections are made by inserting the wires into the holes on the face of the transformer and then secured by a plated set-screw.

A clear plastic cover is provided for these terminals, with a suitable sealing device. Also located at the top of the transformer is a "Full Data" nameplate. The mounting feet of rigid plated steel are permanently fastened to the coil and iron assembly prior to the moulding operation.

ACCURACY

0.3 Accuracy for Normal Metering Burdens

The Type ME—Form 6 Voltage Transformer meets the CSA standards for instrument transformers and has been approved by the Department of Consumer and Corporate Affairs.

Accuracy	Burden	V.A.	P.F.
0.3	W	12.5	10%
0.6	X	25	70%

THERMAL RATINGS

Continuous Thermal Rating 200 Volt-Amps.

The Type ME—Form 6 Voltage Transformer is a group 1 transformer and complies to the thermal requirements of CSA standard C13-1970.

INSULATION CLASS—600 VOLTS

The Type ME—Form 6 Voltage Transformer is intended for use in circuits in which the potential does not exceed 600 volts. The Canadian Standards Association's test requirements for this insulation class are as follows:

Primary Low Frequency Test
—4.0 KV RMS

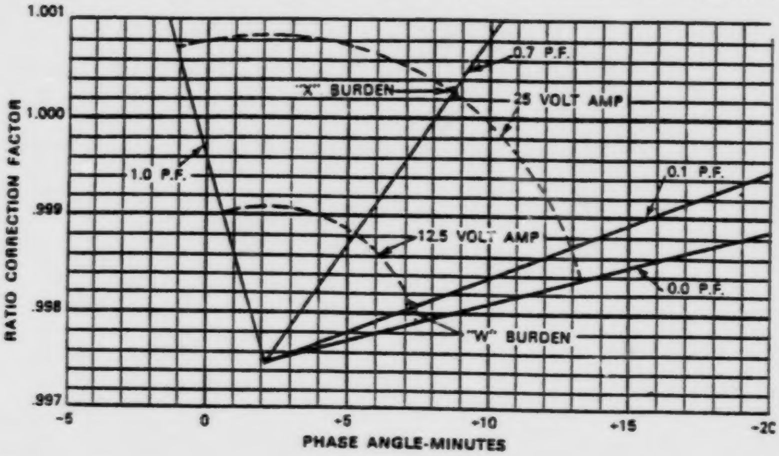
Secondary Low Frequency Test
—2500 VOLTS RMS

Standard Impulse Test
—10 KV FULL WAVE

SANGAMO

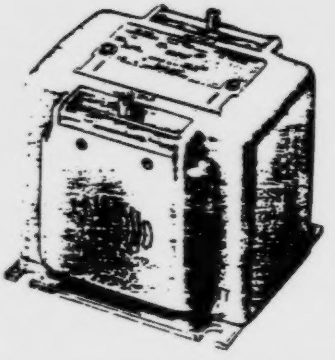
Head Office 219 LAIRD DRIVE TORONTO M4G 3X1 CANADA
Sales Offices Vancouver Calgary Winnipeg Thunder Bay Montreal
Halifax Saint John N.B. St. John's Nfld.

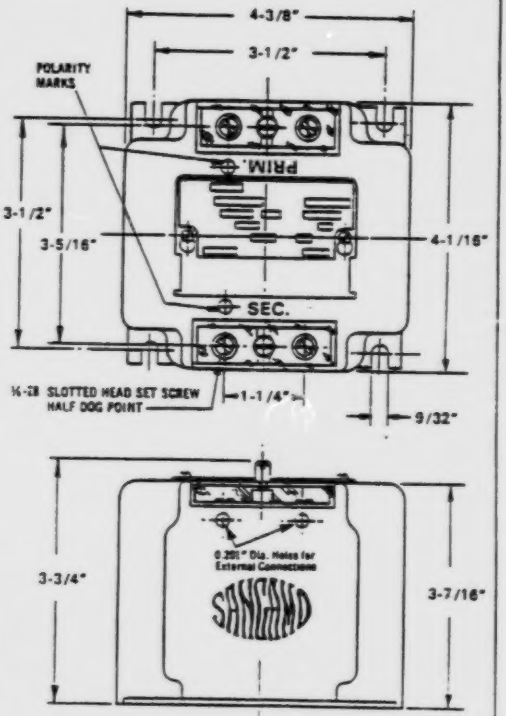
TYPICAL ACCURACY CHARACTERISTICS OF TYPE ME—FORM 6 VOLTAGE TRANSFORMER



The dotted curves which are arcs centred on "zero" burden represents the accuracy curves of the transformer for burdens of 12.5 volt-amps and 25 volt-amps respectively with the lagging power factor of the burden varying from 0 to 1.0.

DIMENSIONS FOR TYPE ME—FORM 6 VOLTAGE TRANSFORMER




4-3/8"
3-1/2"
POLARITY MARKS
PRIM.
SEC.
3-1/2"
3-5/16"
4-1/16"
¼-28 SLOTTED HEAD SET SCREW HALF DOG POINT
1-1/4"
9/32"
3-3/4"
3-7/16"
0.201" Dia. Holes for External Connections
SANGAMO

SHIPPING DATA

The Type ME—Form 6 Voltage Transformers are packed two to a carton.

Approximate weights are as follows:

NET WEIGHT—8 lbs per transformer

GROSS WEIGHT—17½ lbs per carton

E.6; Data Acquisition and System Control Equipment

Item	Qty	Description
01	1	3054S 3054 Data Acquisiton & Control System plus one of the following controllers;85B 9816A/S;9825T; 9826A/S;9836A/C/S;9845B.
02	1	3054A Automatic Data Acquisition/Control System; Contains a 3497A scanner; a 3456A DVM; a 3437A DVM; a 30" rack verification card; system software and documentation.
	3	OPTION 010 20 CHANNEL RELAY MULTIPLEXER: 20 channel low thermal EMF Reed relay multiplexer. LOW LEVEL SWITCHING
	1	OPTION 230 CLOCK FORMAT; Month; Day; Hours; Minutes; Seconds (U.S.)
	1	OPTION 261 DELETE 3437A DVM: Delete the 3437A digital voltmeter and its accompanying HP-IB cable.
	1	OPTION 262 DELETE 3456A DVM: Delete the 3456A digital voltmeter and its accompanying HP-IB cable.
	1	OPTION 280 ADD 5-½ DIGIT DVM: Add 5-½ digit DVM assembly to the 3497A. DVM is programmable, includes current source for resistance measurements.
	1	OPTION 326 120V 60HZ: Power line opt for 120V 60 HZ operation.

Item	Qty	Description
02	1	OPTION 400 DELETE 30" CABINET: Delete standard 30" system cabinet and provide rack mount flanges for all system instruments.
03	1	7470A 2-Pen Graphics Plotter; ISO A4 or 8½x11 In. Chart Sz; MUST specify 1 Interface option to complete unit; Operators Manual and HP-GL Programming Manual 07470-90001 supplied.
	1	OPTION 002 HP-IB, Interface Option uses HP-GL Language; No cable supplied.
	1	OPTION 951 INSTRUMENT SUPPORT CODE
04	1	2225A Inkjet Serial Graphics Printer with HP-IB Selectable Voltage, AC power.
	1	OPTION 951 INSTRUMENT SUPPORT CODE
05	4	10833B TWO METER HP-IB CABLE - SHIELDED
06	1	9816S Instrument controller for above system with 512K bytes R/W memory, graphics & RAM-based BASIC 2.0. Must specify media option 630 or 650 or delete option (256).
	1	OPTION 630 For use with external 3½" disc drives
	1	OPTION 805 Substitute large ASCII keyboard
	1	OPTION 951 INSTRUMENT SUPPORT CODE

Item	Qty	Description
07	1	HP 9121D 3½" FLEX DISC
	1	OPTION 951 INSTRUMENT SUPPORT CODE

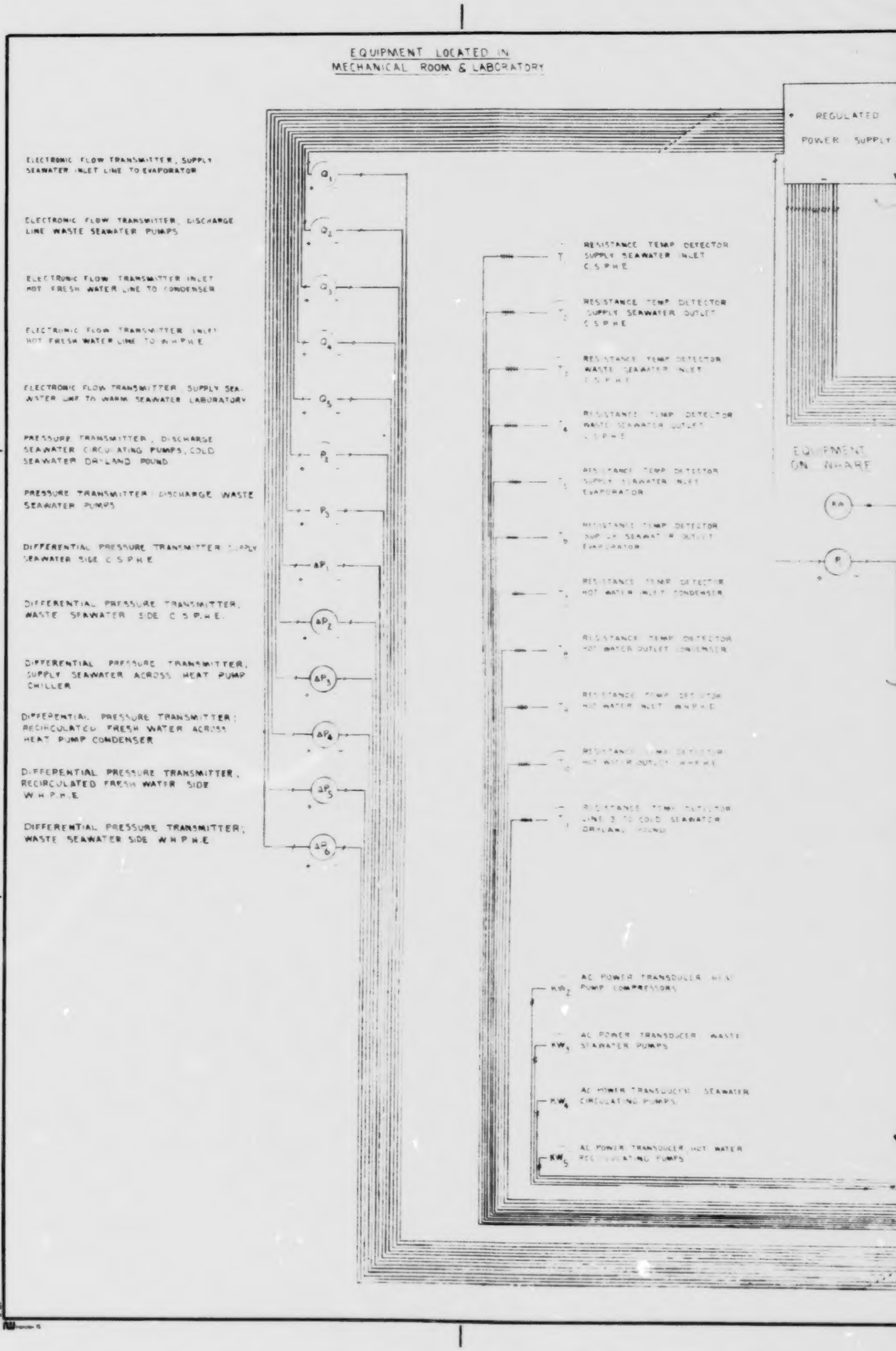
APPENDIX 'F' - MONITORING INSTRUMENTATION INSTALLATION DETAILS

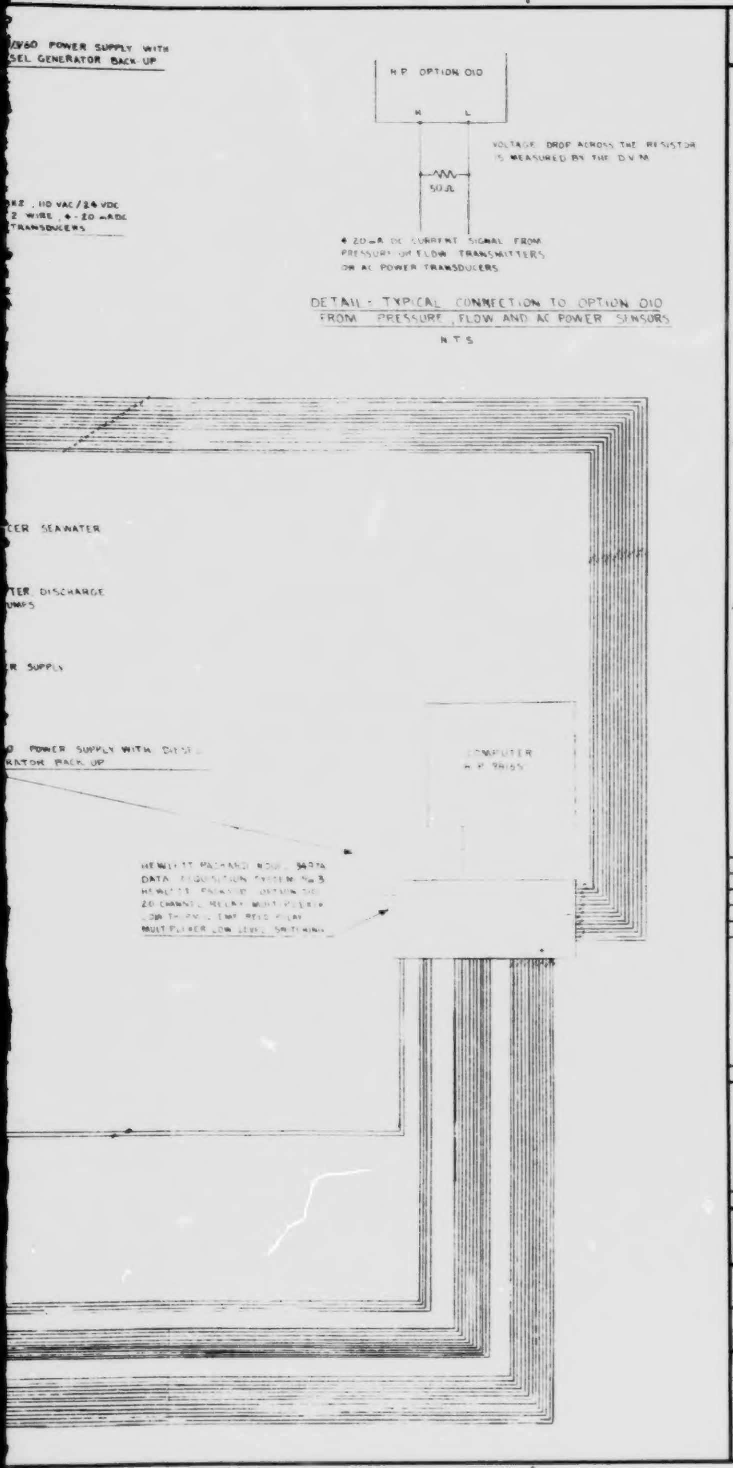
Figure F.1; Monitoring System Wiring Diagram

Figure F.2; Monitoring Equipment Installation Details

Figure F.3; Monitoring Equipment Installation Details

Figure F.4; Wiring Details for Power Load Transducers


EQUIPMENT LOCATED IN MECHANICAL ROOM & LABORATORY
REGULATED POWER SUPPLY
ELECTRONIC FLOW TRANSMITTER, SUPPLY SEAWATER INLET LINE TO EVAPORATOR
ELECTRONIC FLOW TRANSMITTER, DISCHARGE LINE WASTE SEAWATER PUMPS
ELECTRONIC FLOW TRANSMITTER INLET HOT FRESH WATER LINE TO CONDENSER
ELECTRONIC FLOW TRANSMITTER INLET HOT FRESH WATER LINE TO W.H.P.H.E.
ELECTRONIC FLOW TRANSMITTER SUPPLY SEAWATER LINE TO WARM SEAWATER LABORATORY
PRESSURE TRANSMITTER, DISCHARGE SEAWATER CIRCULATING PUMPS, COLD SEAWATER DRY-LAND POUND
PRESSURE TRANSMITTER DISCHARGE WASTE SEAWATER PUMPS
DIFFERENTIAL PRESSURE TRANSMITTER SUPPLY SEAWATER SIDE C.S.P.H.E.
DIFFERENTIAL PRESSURE TRANSMITTER, WASTE SEAWATER SIDE C.S.P.H.E.
DIFFERENTIAL PRESSURE TRANSMITTER, SUPPLY SEAWATER ACROSS HEAT PUMP CHILLER
DIFFERENTIAL PRESSURE TRANSMITTER; RECIRCULATED FRESH WATER ACROSS HEAT PUMP CONDENSER
DIFFERENTIAL PRESSURE TRANSMITTER, RECIRCULATED FRESH WATER SIDE W.H.P.H.E.
DIFFERENTIAL PRESSURE TRANSMITTER; WASTE SEAWATER SIDE W.H.P.H.E.
Q_1
Q_2
Q_3
Q_4
Q_5
P_2
P_3
ΔP_1
ΔP_2
ΔP_3
ΔP_4
ΔP_5
ΔP_6
T_1 RESISTANCE TEMP DETECTOR SUPPLY SEAWATER INLET C.S.P.H.E.
T_2 RESISTANCE TEMP DETECTOR SUPPLY SEAWATER OUTLET C.S.P.H.E.
T_3 RESISTANCE TEMP DETECTOR WASTE SEAWATER INLET C.S.P.H.E.
T_4 RESISTANCE TEMP DETECTOR WASTE SEAWATER OUTLET C.S.P.H.E.
T_5 RESISTANCE TEMP DETECTOR SUPPLY SEAWATER INLET EVAPORATOR
T_6 RESISTANCE TEMP DETECTOR SUPPLY SEAWATER OUTLET EVAPORATOR
T_7 RESISTANCE TEMP DETECTOR HOT WATER INLET CONDENSER
T_8 RESISTANCE TEMP DETECTOR HOT WATER OUTLET CONDENSER
T_9 RESISTANCE TEMP DETECTOR HOT WATER INLET W.H.P.H.E.
T_{10} RESISTANCE TEMP DETECTOR HOT WATER OUTLET W.H.P.H.E.
T_{11} RESISTANCE TEMP DETECTOR LINE 3 TO COLD SEAWATER DRYLAND POUND
EQUIPMENT ON WHARF
KW
P
KW_2 AC POWER TRANSDUCER HEAT PUMP COMPRESSORS
KW_3 AC POWER TRANSDUCER WASTE SEAWATER PUMPS
KW_4 AC POWER TRANSDUCER SEAWATER CIRCULATING PUMPS
KW_5 AC POWER TRANSDUCER HOT WATER RECIRCULATING PUMPS


…/60 POWER SUPPLY WITH
…SEL GENERATOR BACK UP
…HZ, 110 VAC/24 VDC
2 WIRE, 4-20 mADC
…TRANSDUCERS
H.P. OPTION 010
H
L
VOLTAGE DROP ACROSS THE RESISTOR IS MEASURED BY THE D.V.M.
50 Ω
4-20 mA DC CURRENT SIGNAL FROM PRESSURE OR FLOW TRANSMITTERS OR AC POWER TRANSDUCERS
DETAIL: TYPICAL CONNECTION TO OPTION 010 FROM PRESSURE, FLOW AND AC POWER SENSORS
N.T.S.
…CER SEAWATER
…TER DISCHARGE
…UMPS
…R SUPPLY
…0 POWER SUPPLY WITH DIESEL
…RATOR BACK UP
COMPUTER
H.P. 9816S
HEWLETT PACKARD MODEL 3497A DATA ACQUISITION SYSTEM No. 3
HEWLETT PACKARD OPTION 010
20 CHANNEL RELAY MULTIPLEXER
LOW THERMAL EMF REED RELAY MULTIPLEXER LOW LEVEL SWITCHING

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION

EQUIPMENT SPECIFICATIONS:

T_1-T_5, T_8	RESISTANCE TEMPERATURE DETECTORS THERMO KINETICS 3 WIRE 100 Ω RTD 1/4" DIAM. SPRING LOADED IN CAST HEAD NIPPLE AND 316 SS THERMOWELL, 3/4" PROCESS CONNECTION, 4-1/2" BELOW THREADS INSERTION # RAII-D100A3 6 WB3-KW//16-0049-4 1/2-316-3/4
T_7 T_{10}	SAME AS ABOVE EXCEPT THERMOWELL INSERTION IS 2-1/2" BELOW THREADS # RAII-D100A3-4 WB3-KW//16 0049-2 1/2-316-3/4
Q_1 Q_2, Q_5	BARTON TYPE 6002 ELECTRONIC FLOW TRANSMITTER, 316 SS WETTED PARTS 4-20 mADC OUTPUT LOCAL INDICATION WITH RANGE 0 TO 100" WC MODEL 6002-11 02 01 02-01 02-H1 … 6" - 316 SS ORIFICE PLATES FOR 150 lb / SCH 40 PVC PIPE
Q_3 Q_4	SAME AS ABOVE EXCEPT … 3" - 316 SS ORIFICE PLATES FOR 150 lb / SCH 40 STEEL PIPE
P_2	PHILIPS - P2 PRESSURE TRANSMITTER OUTPUT 4-20 mADC RANGE 0-60 PSI MODEL # 9404 215 62171
P_1 P_3	SAME AS ABOVE EXCEPT RANGE 0 TO 100 PSIG MODEL # 9404 215 62181
kW_1, kW_5	[illegible] MODEL W20 4 0 4 AC POWER TRANSDUCER … SANGAMO MV-6 2 WIRE 600 V CLASS CURRENT TRANSFORMER (SEE NOTES BELOW)
kW_1	REQUIRES 4 - 150A MV-6 2 WIRE 600 V CLASS INDOOR CURRENT TRANSFORMERS
kW_2	REQUIRES 3 - 400A SANGAMO MV-6 2 WIRE 600 V CLASS INDOOR CURRENT TRANSFORMERS
kW_3	REQUIRES 3 - 75A SANGAMO MV-6 2 WIRE 600 V CLASS INDOOR CURRENT TRANSFORMERS
kW_4	REQUIRES 3 - 200A SANGAMO MV-6 2 WIRE 600 V CLASS INDOOR CURRENT TRANSFORMERS
kW_5	REQUIRES 3 - 30A SANGAMO MV-6 2 WIRE 600 V CLASS INDOOR CURRENT TRANSFORMERS
ΔP_1 - ΔP_5	BARTON MODEL 6001 DIFFERENTIAL PRESSURE TRANSMITTER 316 SS WETTED PARTS 4-20 mA DC OUTPUT SENSOR RANGE 0 - 46 PSI MODEL # 6001-16-02 01 01 01-01-01

NO	DATE	REVISION	BY

KEY PLAN

SUB-CONSULTANTS

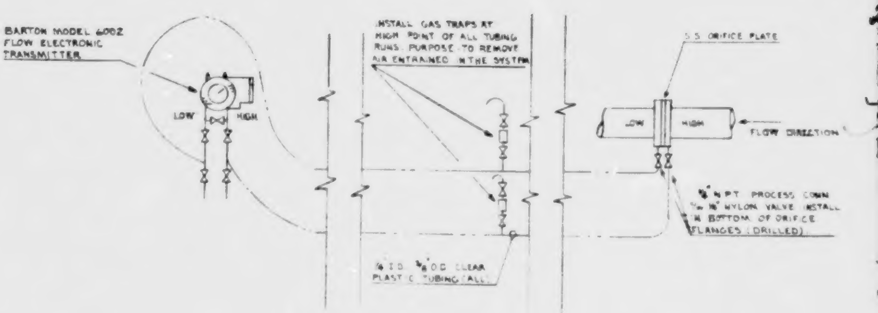
A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA

CLIENT: CLEARWATER LOBSTERS LTD
CLARK'S HARBOUR, N.S.

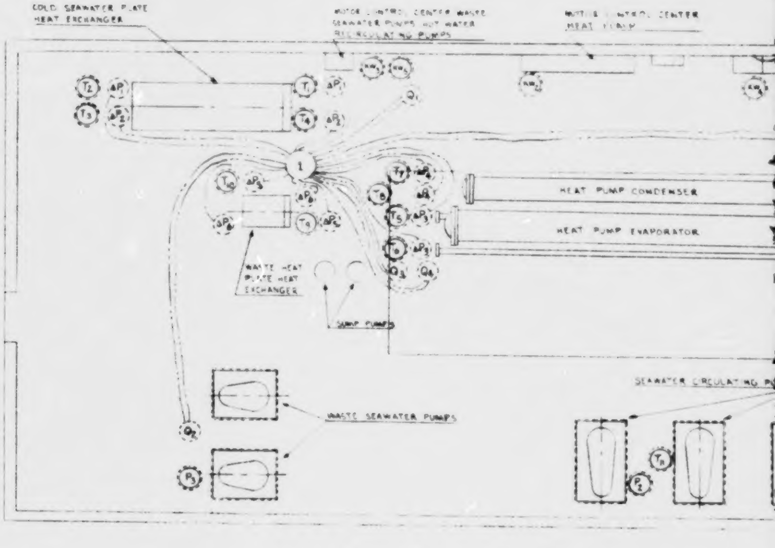
PROJECT: OCEAN SOURCE HEAT PUMP
MONITORING SYSTEM WIRING DIAG

DRAWN BY: T.S.	SCALE: N.T.S.
TRACED BY:	DATE: AUG 1984
CHECKED BY:	APPROVED BY:
PROJECT NO. 226	DRAWING NO. MSE-01

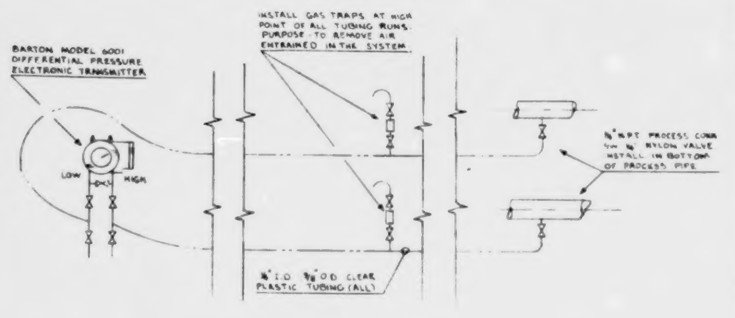
Figure F.1


BARTON MODEL 6002 FLOW ELECTRONIC TRANSMITTER
LOW
HIGH
INSTALL GAS TRAPS AT HIGH POINT OF ALL TUBING RUNS. PURPOSE: TO REMOVE AIR ENTRAINED IN THE SYSTEM
S.S. ORIFICE PLATE
LOW
HIGH
FLOW DIRECTION
⅜" N.P.T. PROCESS CONN. ⅜ × ⅜" NYLON VALVE INSTALL IN BOTTOM OF ORIFICE FLANGES (DRILLED)
¼" I.D. ⅜" O.D. CLEAR PLASTIC TUBING (ALL)

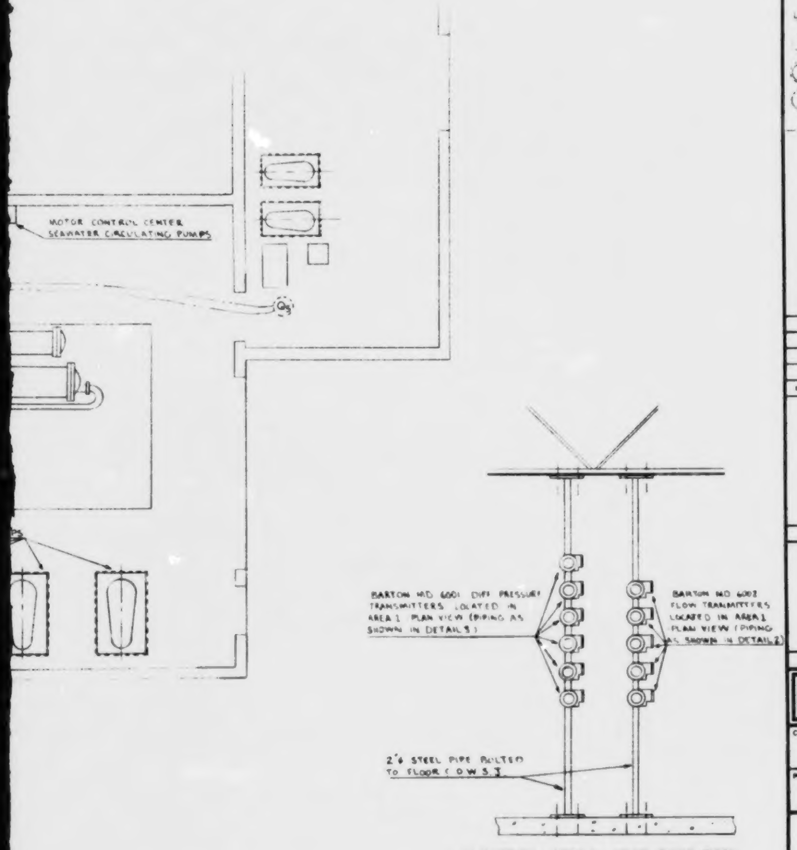
DETAIL 2: TYPICAL PIPING LAYOUT
FLOW MEASUREMENT
N.T.S.


COLD SEAWATER PLATE HEAT EXCHANGER
MOTOR CONTROL CENTER WASTE SEAWATER PUMPS HOT WATER RECIRCULATING PUMPS
MOTOR CONTROL CENTER HEAT PUMP
T2
T3
ΔP1
ΔP2
T1
T4
KW1
KW3
KW2
Q1
1
T10
ΔP5
ΔP6
T9
T7
T8
T5
T6
Q3
Q4
HEAT PUMP CONDENSER
HEAT PUMP EVAPORATOR
WASTE HEAT PLATE HEAT EXCHANGER
SUMP PUMPS
SEAWATER CIRCULATING P
WASTE SEAWATER PUMPS
Q2
P3
P2
Tn

PLAN VIEW: HEAT PUMP ROOM
PROCESS MONITORING POINTS LOCATIONS
SCALE: ¼" = 1'-0"


INSTALL GAS TRAPS AT HIGH POINT OF ALL TUBING RUNS. PURPOSE TO REMOVE AIR ENTRAINED IN THE SYSTEM.
BARTON MODEL 6001 DIFFERENTIAL PRESSURE ELECTRONIC TRANSMITTER
LOW
HIGH
¼" NPT PROCESS CONN. c/w ¼" NYLON VALVE INSTALL IN BOTTOM OF PROCESS PIPE
¼" I.D. ⅜" O.D. CLEAR PLASTIC TUBING (ALL)

DETAIL 3: TYPICAL PIPING LAYOUT
DIFFERENTIAL PRESS MEASUREMENT
N.T.S.


MOTOR CONTROL CENTER SEAWATER CIRCULATING PUMPS
BARTON MD 6001 DIFF PRESSURE TRANSMITTERS LOCATED IN AREA 1 PLAN VIEW (PIPING AS SHOWN IN DETAIL 3)
BARTON MD 6002 FLOW TRANSMITTERS LOCATED IN AREA 1 PLAN VIEW (PIPING AS SHOWN IN DETAIL 2)
2" ⌀ STEEL PIPE BOLTED TO FLOOR (O.W.S.)

ELEVATION: AREA 1 - HEAT PUMP ROOM
SCALE ½" - 1'-0"

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION

NOTES:

1. SENSORS P1, KW1 ARE LOCATED IN THE PUMP HOUSE ON THE WHARF
2. FOR INSTALLATION DIAGRAMS OF POWER, PRESSURE AND TEMP SENSORS SEE DRWG ME-01.
3. ALL TUBING SHALL BE ¼" I.D., ⅜" O.D. CLEAR PLASTIC TUBING
4. ALL VALVES AND FITTINS SHALL BE ¼" I.D. NYLON OR PLASTIC.

LEGEND:

( ) LOCATION OF PROCESS CONNECTION FOR REMOTE SENSORS (DIFF. PRESS. & FLOW)
○ LOCATION OF PROCESS CONNECTION AND SENSOR
(1) LOCATION OF ALL REMOTE SENSORS (DIFF. PRESS. & FLOW) SEE ELEVATION: AREA 1, BELOW.
— — ¼" I.D. ⅜" O.D. CLEAR PLASTIC TUBING

NO	DATE	REVISION	BY

KEY PLAN

SUB - CONSULTANTS

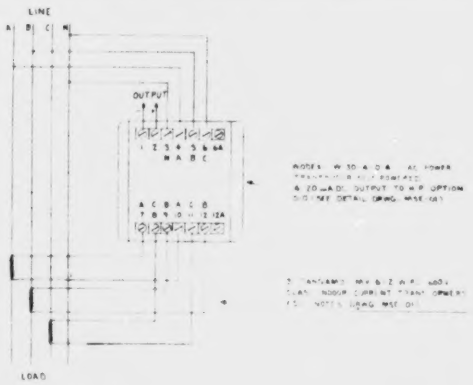
A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA

CLIENT
CLEARWATER LOBSTERS LTD.
CLARK'S HARBOUR, N.S.

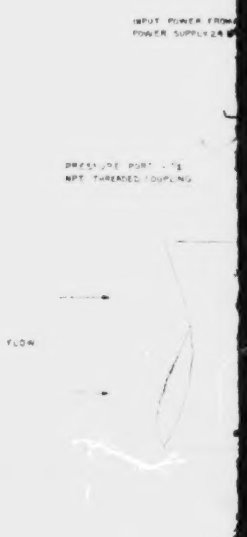
PROJECT
OCEAN SOURCE HEAT PUMP
MONITORING EQUIPMENT INSTALL.

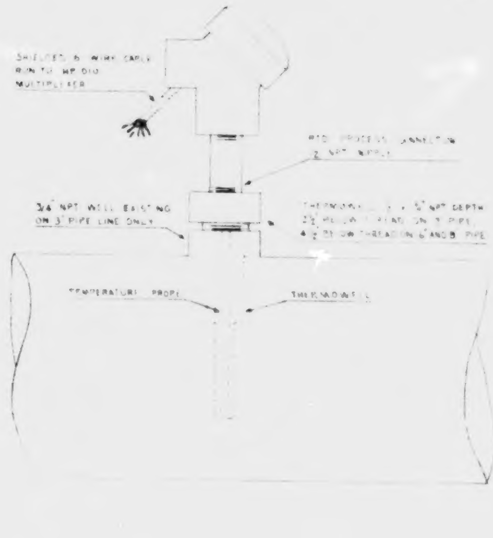
DRAWN BY T.S.	SCALE AS SHOWN
TRACED BY	DATE FEB. /85
CHECKED BY	APPROVED BY
PROJECT NO. 226	DRAWING NO. ME-02

Figure F.2

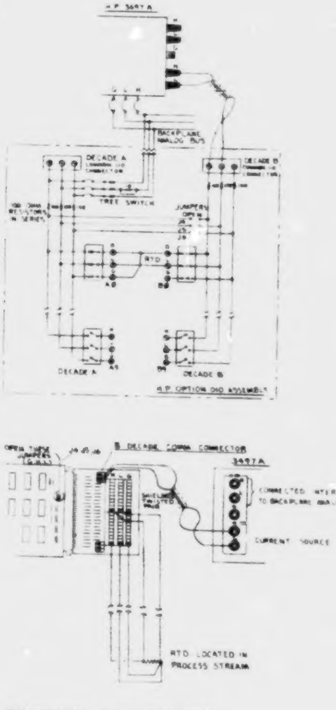

LINE
A
B
C
N
OUTPUT
1 2 3 4 5 6 6A
N A B C
A C B A C B
7 8 9 10 11 12 12A
MODEL W 30 A O A AC POWER TRANSDUCER SELF POWERED 4-20 mA DC OUTPUT TO H.P. OPTION 010 (SEE DETAIL DRWG. MSE-01)
3 CURRENT TRANSFORMERS (SEE NOTES DRWG MSE-01)
LOAD

AC POWER TRANSDUCER
TYPICAL WIRING DIAGRAM
N.T.S.


INPUT POWER FROM
POWER SUPPLY 24
PRESSURE PORT
NPT THREADED COUPLING
FLOW

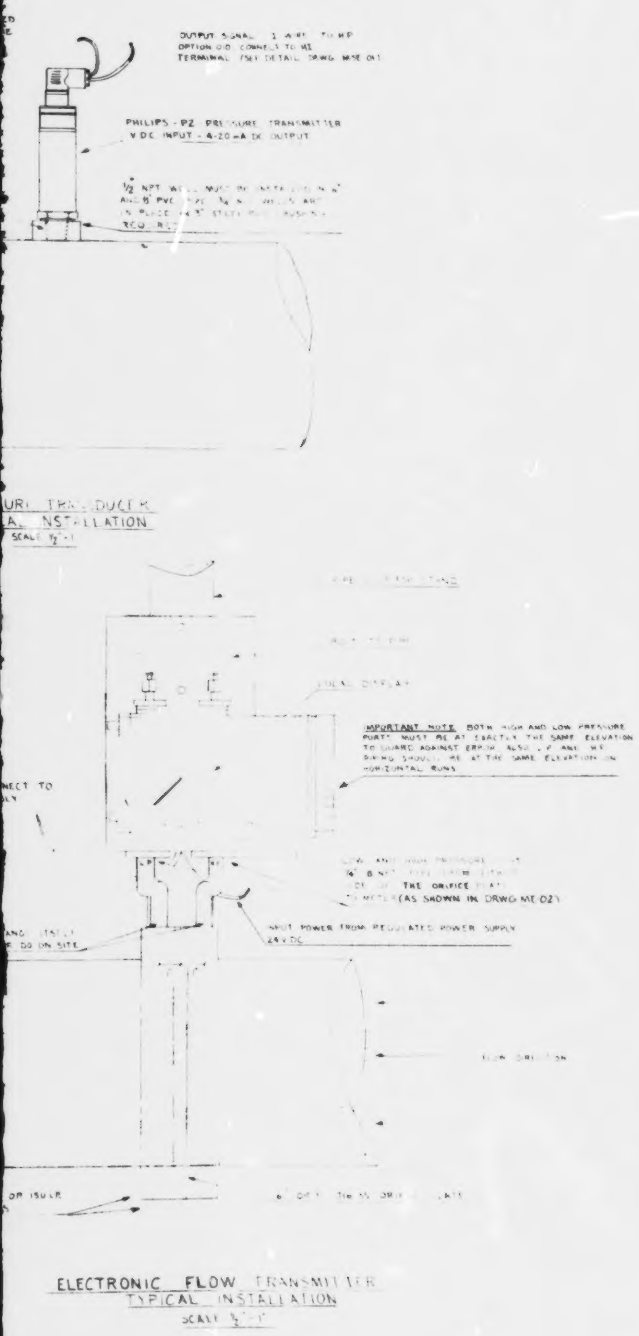

SHIELDED 6 WIRE CABLE RUN TO HP 010 MULTIPLEXER
RTD PROCESS CONNECTION 1/2" NPT NIPPLE
3/4" NPT WELL EXISTING ON 3" PIPE LINE ONLY
THERMOWELL 3/4" NPT DEPTH 2 1/2" BELOW THREAD ON 3" PIPE, 4 1/2" BELOW THREAD ON 6" AND 8" PIPE
TEMPERATURE PROBE
THERMOWELL

RESISTANCE TEMP DETECTOR
TYPICAL INSTALLATION
SCALE 1:1


H.P. 3497 A
BACKPLANE ANALOG BUS
DECADE A
DECADE B
TREE SWITCH
100 OHM RESISTORS IN SERIES
JUMPERS OPEN
RTD
DECADE A
DECADE B
H.P. OPTION 010 ASSEMBLY
OPEN THESE JUMPERS
B DECADE COMM CONNECTOR
3497A
SHIELDED TWISTED PAIR
CONNECTED INTERNALLY TO BACKPLANE ANALOG BUS
CURRENT SOURCE
RTD LOCATED IN PROCESS STREAM

RESISTANCE TEMP DETECTOR
TYPICAL WIRING DIAGRAM
N.T.S.

RED WIRE
HI TERMINAL
(SEE DETAIL DRWG
SCH 40 6" PVC
SCH 40 3" ST


OUTPUT SIGNAL 1 WIRE TO HP
OPTION 010 CONNECT TO HI
TERMINAL (SEE DETAIL DRWG ME 01)
PHILIPS - PZ PRESSURE TRANSMITTER
VDC INPUT - 4-20mA DC OUTPUT
½ NPT WELL MUST BE INSTALLED IN 6" AND 8" PVC PIPE ¾ NPT WELLS ARE IN PLACE 3" STEEL BUSHING REQUIRED
URE TRANSDUCER
AL INSTALLATION
SCALE ½"-1
LOCAL DISPLAY
IMPORTANT NOTE BOTH HIGH AND LOW PRESSURE PORTS MUST BE AT EXACTLY THE SAME ELEVATION TO GUARD AGAINST ERROR ALSO LP AND HP PIPING SHOULD BE AT THE SAME ELEVATION ON HORIZONTAL RUNS
NECT TO
LY
LP
HP
LOW AND HIGH PRESSURE ¼" 8 NPT THE ORIFICE TO METER (AS SHOWN IN DRWG ME 02)
DO ON SITE
INPUT POWER FROM REGULATED POWER SUPPLY 24 V DC
FLOW DIRECTION
OR ISOLR
ELECTRONIC FLOW TRANSMITTER
TYPICAL INSTALLATION
SCALE ½"-1"

○ PRELIMINARY DESIGN
○ FINAL DESIGN
○ APPROVED FOR CONSTRUCTION

NOTES:

DIFFERENTIAL PRESSURE TRANSMITTERS ARE INSTALLED SIMILAR TO THE ELECTRIC FLOW TRANSMITTER. DIFFERENCES ARE (1) NO ORIFICE PLATES ARE REQUIRED WITH THE DIFF. PRESS. TRANSMITTERS (2) PROCESS CONNECTIONS MAY BE IN FLANGES OR PIPE SADDLES WITH THE DIFF. PRESS. TRANSMITTER (3) HIGH AND LOW PRESS. PROCESS CONNECTIONS MAY BE REMOTE FROM EACH OTHER AND THE TRANSMITTER ON THE DIFFERENTIAL PRESSURE TRANSMITTER

NO	DATE	REVISION	BY

KEY PLAN

SUB - CONSULTANTS

A. ORLIC & ASSOCIATES LIMITED
INDUSTRIAL ENGINEERING CONSULTANTS
HALIFAX NOVA SCOTIA CANADA

CLIENT CLEARWATER LOBSTERS LTD
CLARK'S HARBOUR, N.S.

PROJECT OCEAN SOURCE HEAT PUMP
MONITORING EQUIPMENT INST.

DRAWN BY	T.S	SCALE	AS SHOWN
TRACED BY		DATE	SEPT./84
CHECKED BY		APPROVED BY	
PROJECT NO.	226	DRAWING NO.	ME-01

Figure F.3

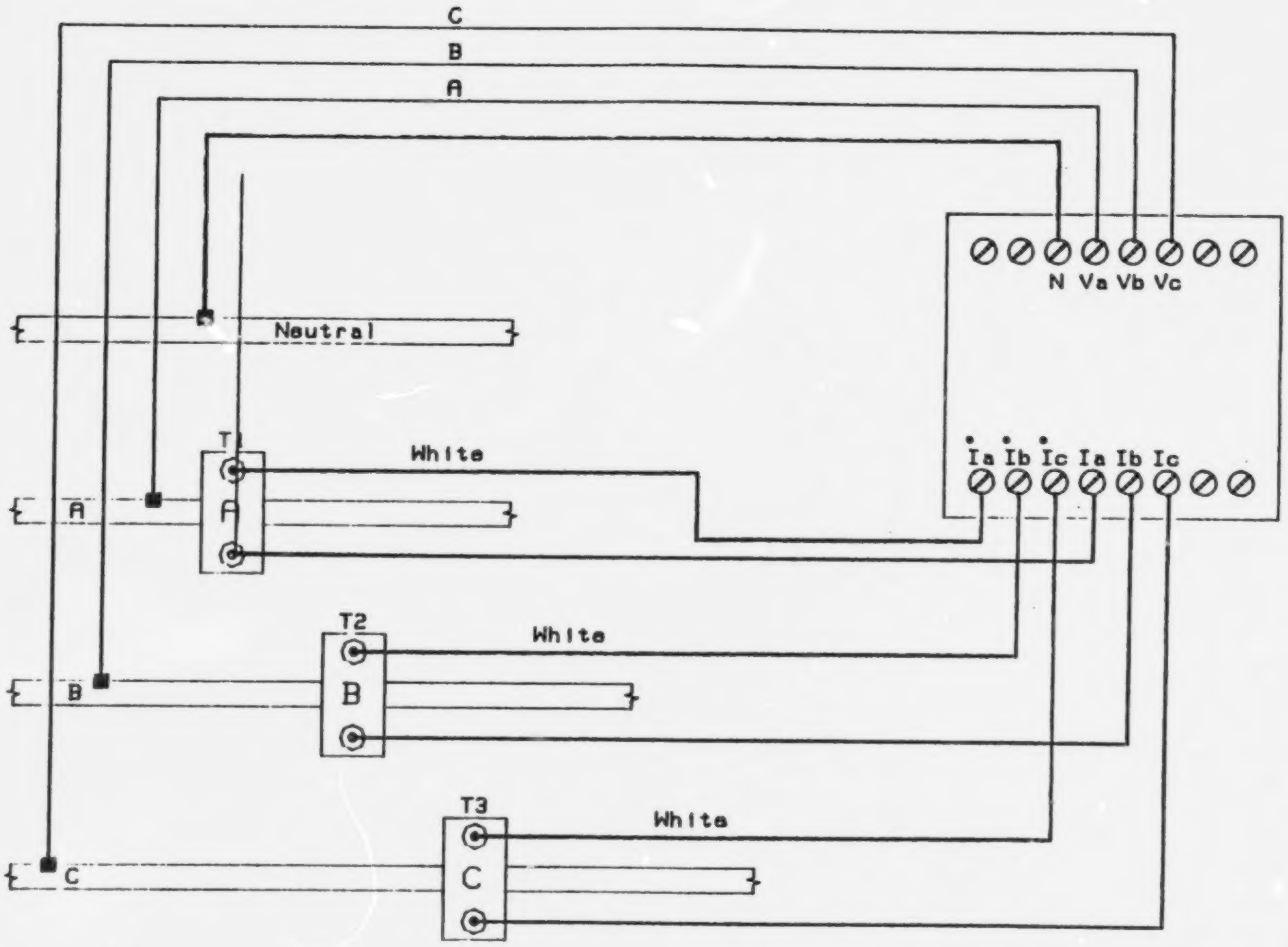
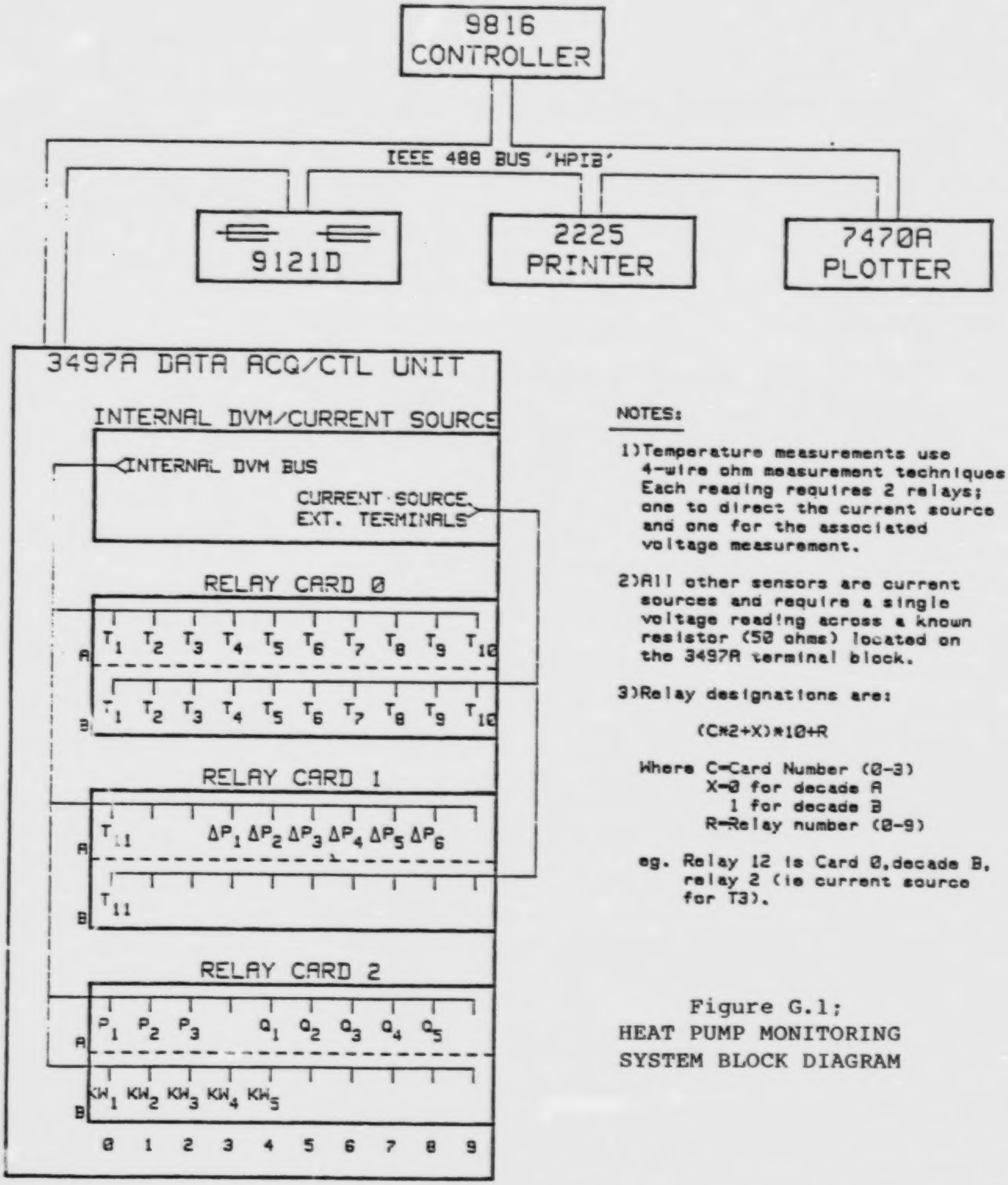

C
B
A
N Va Vb Vc
Neutral
Ia Ib Ic Ia Ib Ic
T1
White
A
A
T2
White
B
B
T3
White
C
C

Figure F.4 - Wiring Details for Power Load Transducers

APPENDIX 'G' - MONITORING PROGRAM FLOW CHARTS

Figure G.1;	Heat Pump Monitoring System Block Diagram
Figure G.2;	Main Program Segment
Figure G.3;	Hourly System Measurement Routine
Figure G.4;	Soft Key Measurement Routine
Figure G.5;	Data Evaluation Routine
Figure G.6;	3497 Measurement Subroutines
Figure G.7;	Data Edit Subroutines - Graphical
Figure G.8;	Final Plots Subroutines - Data only
Figure G.9;	Data Calculation and Output
Figure G.10;	Shut Down Routine


9816
CONTROLLER
IEEE 488 BUS 'HPIB'
9121D
2225
PRINTER
7470A
PLOTTER
3497A DATA ACQ/CTL UNIT
INTERNAL DVM/CURRENT SOURCE
INTERNAL DVM BUS
CURRENT SOURCE
EXT. TERMINALS
RELAY CARD 0
A
T1 T2 T3 T4 T5 T6 T7 T8 T9 T10
B
T1 T2 T3 T4 T5 T6 T7 T8 T9 T10
RELAY CARD 1
A
T11 ΔP1 ΔP2 ΔP3 ΔP4 ΔP5 ΔP6
B
T11
RELAY CARD 2
A
P1 P2 P3 Q1 Q2 Q3 Q4 Q5
B
KW1 KW2 KW3 KW4 KW5
0 1 2 3 4 5 6 7 8 9

NOTES:

1) Temperature measurements use 4-wire ohm measurement techniques Each reading requires 2 relays; one to direct the current source and one for the associated voltage measurement.

2) All other sensors are current sources and require a single voltage reading across a known resistor (50 ohms) located on the 3497A terminal block.

3) Relay designations are:

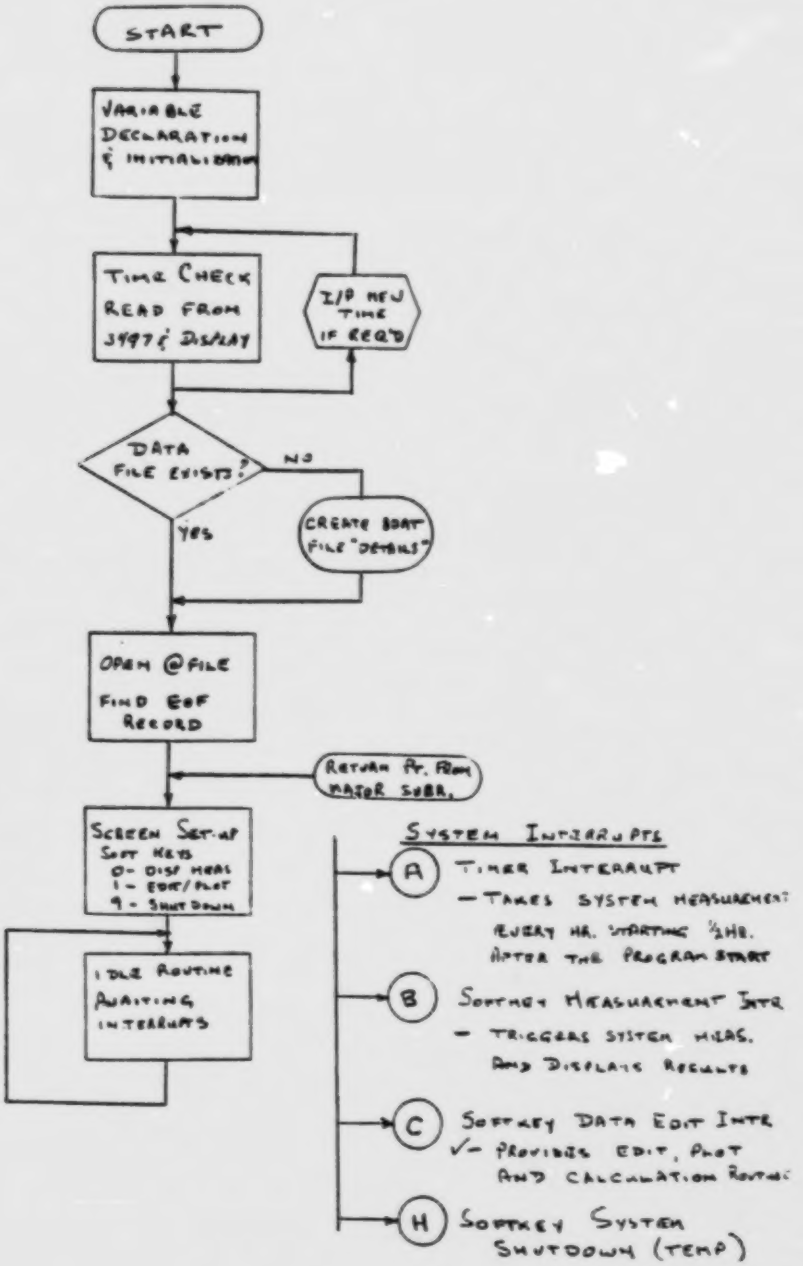
$$(C*2+X)*10+R$$

Where C-Card Number (0-3)
X-0 for decade A
1 for decade B
R-Relay number (0-9)

eg. Relay 12 is Card 0, decade B, relay 2 (ie current source for T3).

Figure G.1;
HEAT PUMP MONITORING SYSTEM BLOCK DIAGRAM

Figure G.2;
MAIN PROGRAM SEGMENT


START
VARIABLE DECLARATION & INITIALIZATION
TIME CHECK READ FROM 3497 & DISPLAY
I/P NEW TIME IF REQ'D
DATA FILE EXISTS?
NO
YES
CREATE BOAT FILE "DETAILS"
OPEN @FILE
FIND EOF RECORD
RETURN PT. FROM MAJOR SUBR.
SCREEN SET-UP
SOFT KEYS
0 - DISP MEAS
1 - EDIT/PLOT
9 - SHUTDOWN
IDLE ROUTINE AWAITING INTERRUPTS
SYSTEM INTERRUPTS
A
TIMER INTERRUPT
— TAKES SYSTEM MEASUREMENT EVERY HR. STARTING ½ HR. AFTER THE PROGRAM START
B
SOFTKEY MEASUREMENT INTR
— TRIGGERS SYSTEM MEAS. AND DISPLAYS RESULTS
C
SOFTKEY DATA EDIT INTR
✓— PROVIDES EDIT, PLOT AND CALCULATION ROUTINE
H
SOFTKEY SYSTEM SHUTDOWN (TEMP)

1 DEC 84

Figure G.3;
HOURLY SYSTEM MEASUREMENTS

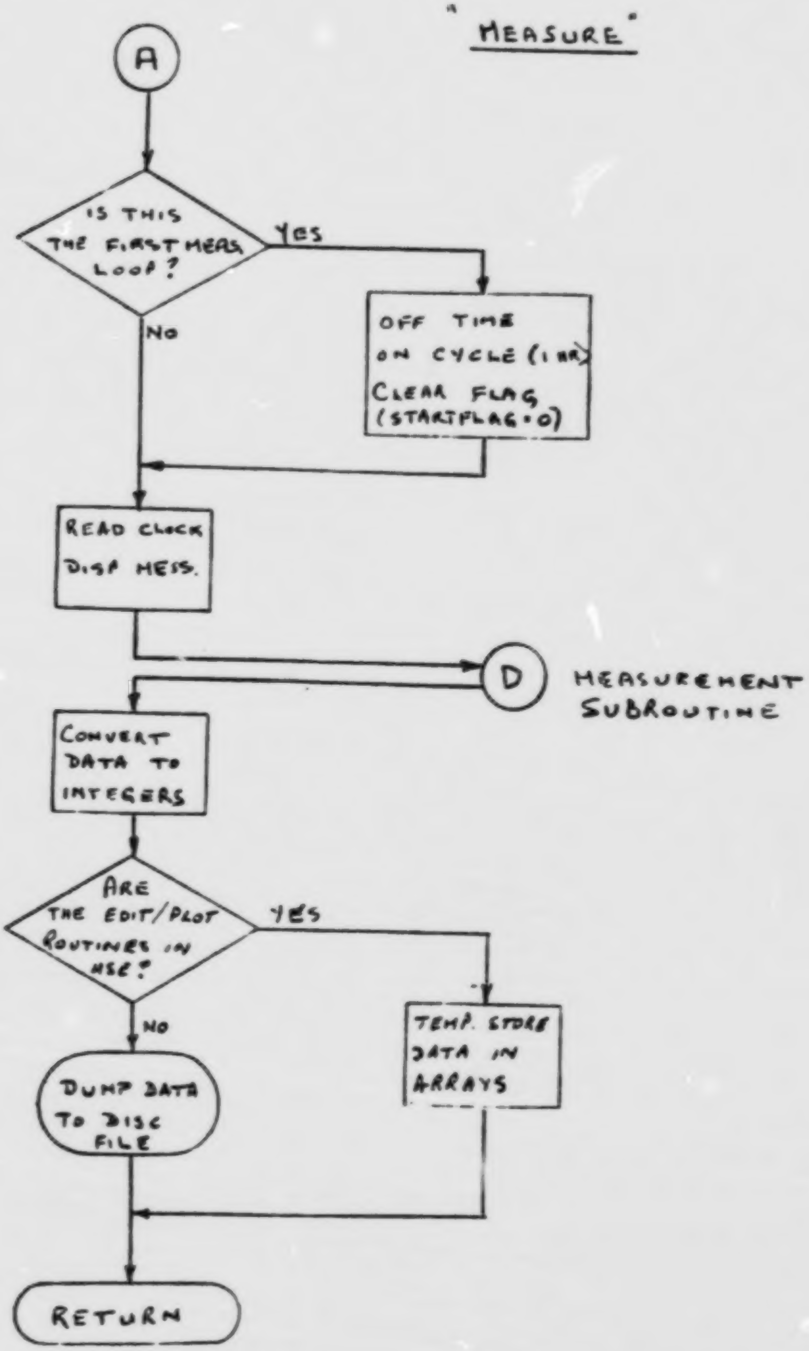
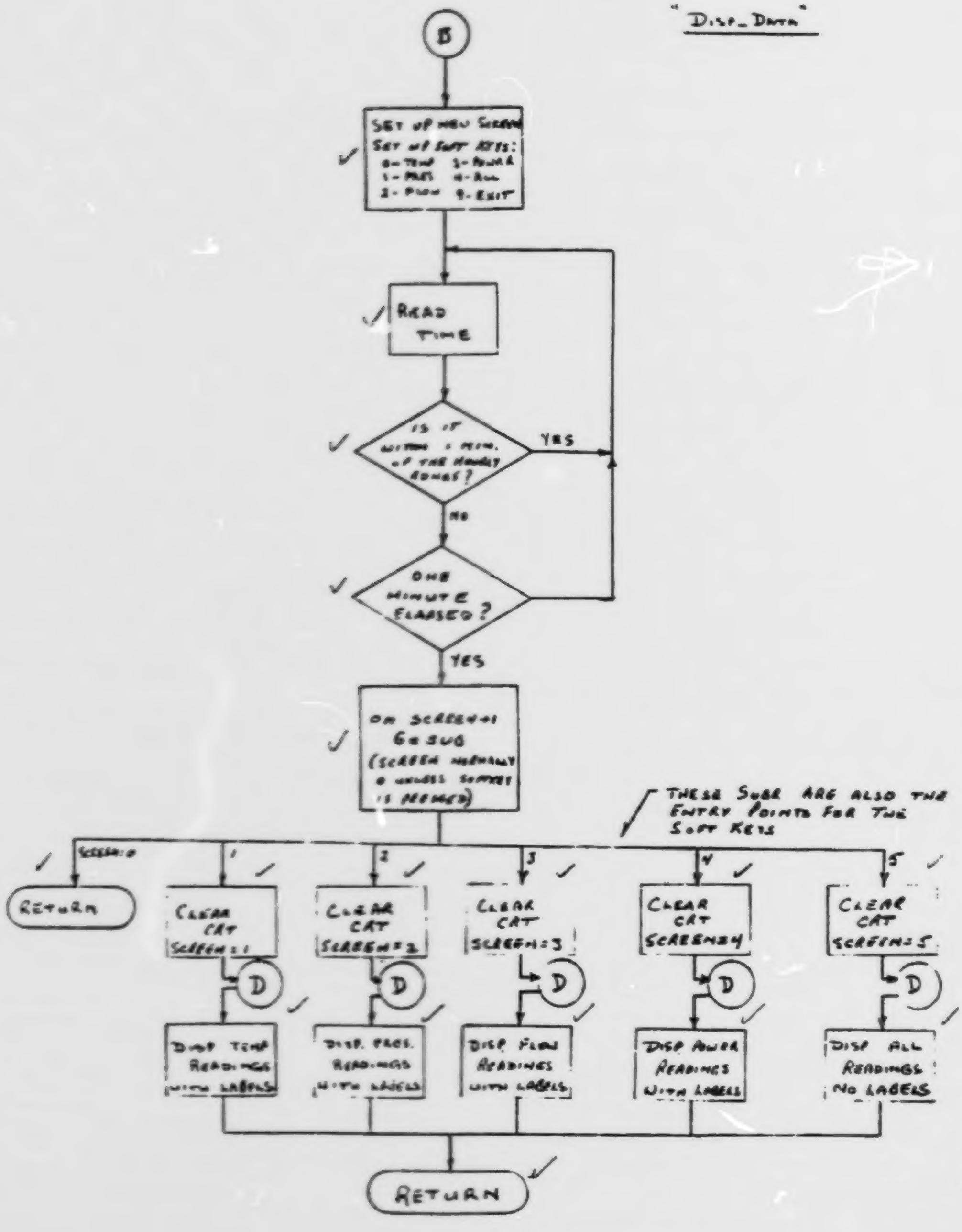

"MEASURE"
A
IS THIS THE FIRST MEAS LOOP?
YES
NO
OFF TIME ON CYCLE (1 HR)
CLEAR FLAG (STARTFLAG=0)
READ CLOCK
DISP MESS.
D
MEASUREMENT SUBROUTINE
CONVERT DATA TO INTEGERS
ARE THE EDIT/PLOT ROUTINES IN USE?
YES
NO
TEMP. STORE DATA IN ARRAYS
DUMP DATA TO DISC FILE
RETURN

Figure G.4;
SOFTKEY MEASUREMENT ROUTINE


"DISP_DATA"
B
SET UP NEW SCREEN
SET UP SOFT KEYS:
0-TEMP 3-POWER
1-PRES 4-ALL
2-FLOW 9-EXIT
READ TIME
IS IT WITHIN 1 MIN. OF THE HOURLY
YES
NO
ONE MINUTE ELAPSED?
YES
ON SCREEN+1 GOSUB (SCREEN NORMALLY 0 UNLESS SOFTKEY IS PRESSED)
THESE SUBR ARE ALSO THE ENTRY POINTS FOR THE SOFT KEYS
SCREEN=0
1
2
3
4
5
RETURN
CLEAR CRT SCREEN=1
CLEAR CRT SCREEN=2
CLEAR CRT SCREEN=3
CLEAR CRT SCREEN=4
CLEAR CRT SCREEN=5
D
D
D
D
D
DISP TEMP READINGS WITH LABELS
DISP. PRES. READINGS WITH LABELS
DISP FLOW READINGS WITH LABELS
DISP POWER READINGS WITH LABELS
DISP ALL READINGS NO LABELS
RETURN

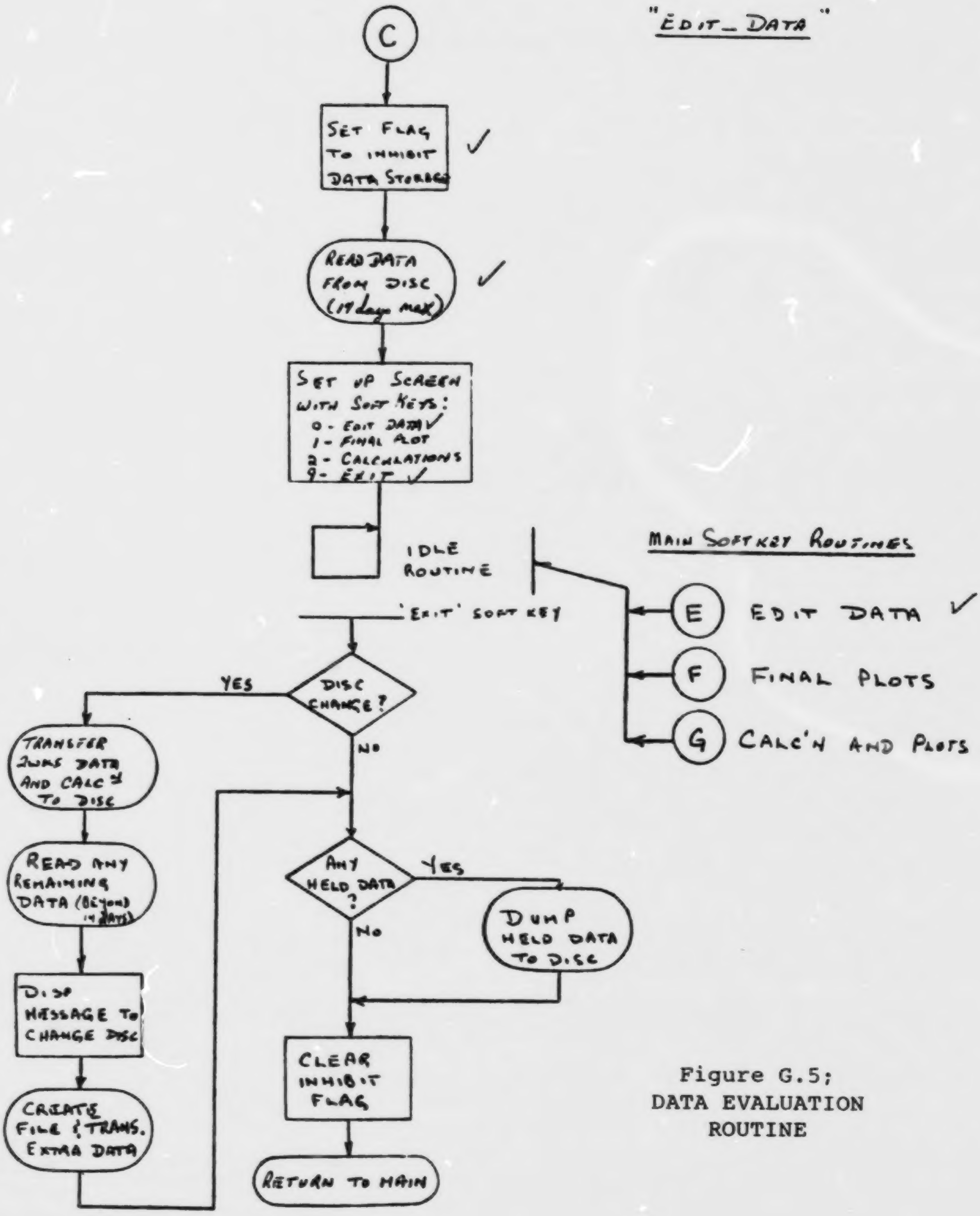

"EDIT_DATA"
C
SET FLAG TO INHIBIT DATA STORAGE ✓
READ DATA FROM DISC (14 days max) ✓
SET UP SCREEN WITH SOFT KEYS:
0 - EDIT DATA ✓
1 - FINAL PLOT
2 - CALCULATIONS
9 - EXIT ✓
IDLE ROUTINE
'EXIT' SOFT KEY
MAIN SOFTKEY ROUTINES
E
EDIT DATA ✓
F
FINAL PLOTS
G
CALC'N AND PLOTS
DISC CHANGE?
YES
NO
TRANSFER 2WKS DATA AND CALC'd TO DISC
READ ANY REMAINING DATA (BEYOND 14 DAYS)
DISP MESSAGE TO CHANGE DISC
CREATE FILE & TRANS. EXTRA DATA
ANY HELD DATA ?
YES
NO
DUMP HELD DATA TO DISC
CLEAR INHIBIT FLAG
RETURN TO MAIN

Figure G.5;
DATA EVALUATION
ROUTINE

"READ_DATA"

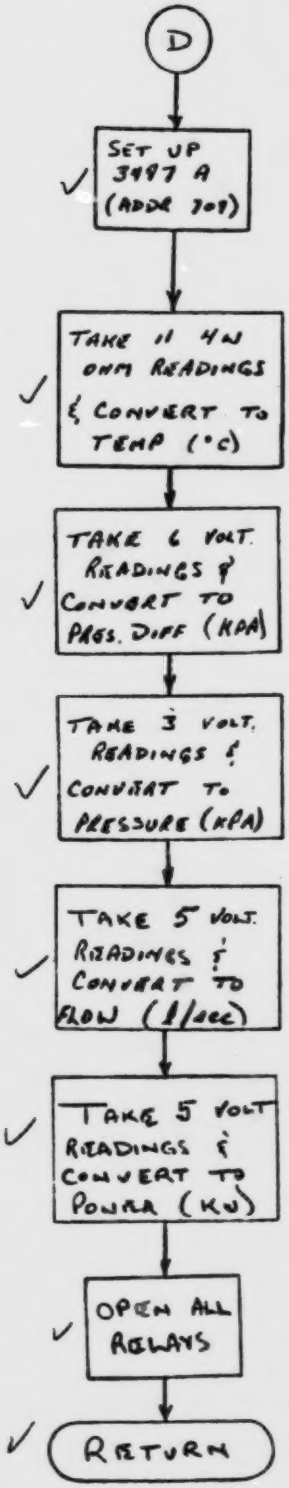
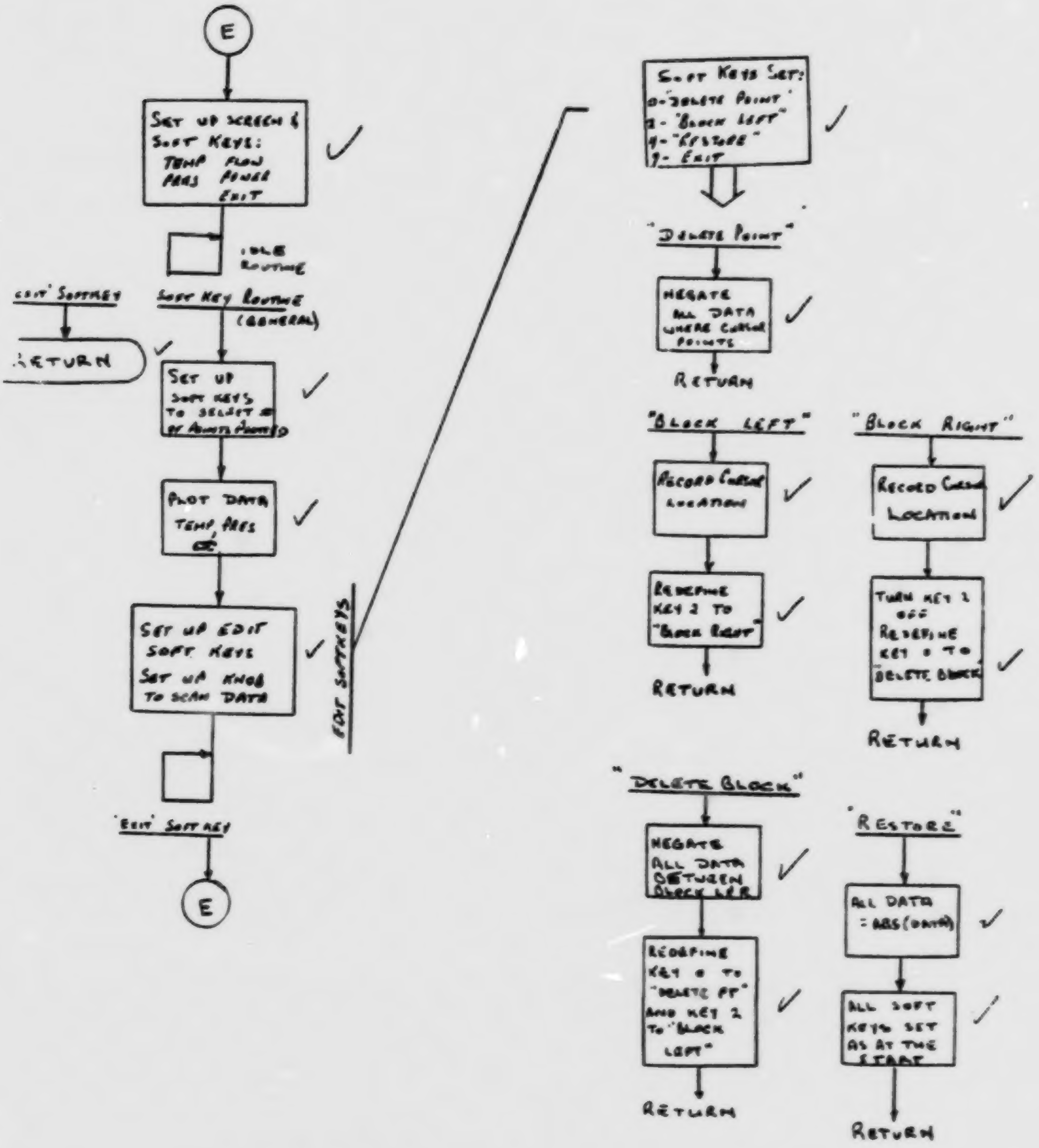

D
SET UP 3497 A (ADDR 709)
TAKE 11 4W OHM READINGS & CONVERT TO TEMP (°C)
TAKE 6 VOLT. READINGS & CONVERT TO PRES. DIFF (KPA)
TAKE 3 VOLT. READINGS & CONVERT TO PRESSURE (KPA)
TAKE 5 VOLT. READINGS & CONVERT TO FLOW (l/sec)
TAKE 5 VOLT READINGS & CONVERT TO POWER (KW)
OPEN ALL RELAYS
RETURN

Figure G.6;
3497 MEASUREMENT
SUBROUTINE

Figure G.7:
DATA EDIT SUBROUTINE (GRAPHICAL)


E
SET UP SCREEN &
SOFT KEYS:
TEMP FLOW
PRES POWER
EXIT
IDLE ROUTINE
'EDIT' SOFTKEY
RETURN
SOFT KEY ROUTINE (GENERAL)
SET UP SOFT KEYS TO SELECT # OF POINTS PLOTTED
PLOT DATA TEMP, PRES, ETC
SET UP EDIT SOFT KEYS
SET UP KNOB TO SCAN DATA
EDIT SOFTKEYS
'EXIT' SOFTKEY
E
SOFT KEYS SET:
0- "DELETE POINT"
2- "BLOCK LEFT"
4- "RESTORE"
9- EXIT
"DELETE POINT"
NEGATE ALL DATA WHERE CURSOR POINTS
RETURN
"BLOCK LEFT"
RECORD CURSOR LOCATION
REDEFINE KEY 2 TO "BLOCK RIGHT"
RETURN
"BLOCK RIGHT"
RECORD CURSOR LOCATION
TURN KEY 2 OFF
REDEFINE KEY 0 TO DELETE BLOCK
RETURN
"DELETE BLOCK"
NEGATE ALL DATA BETWEEN BLOCK L&R
REDEFINE KEY 0 TO "DELETE PT" AND KEY 2 TO "BLOCK LEFT"
RETURN
"RESTORE"
ALL DATA = ABS(DATA)
ALL SOFT KEYS SET AS AT THE START
RETURN

Note: system indicates a point (or points) has been deleted by putting a straight line just above the time axis at the period which the point was deleted. The system does not do this if the points are missing due to system shutdown.

Figure G.8
FINAL PLOTS SUBROUTINE (DATA ONLY)

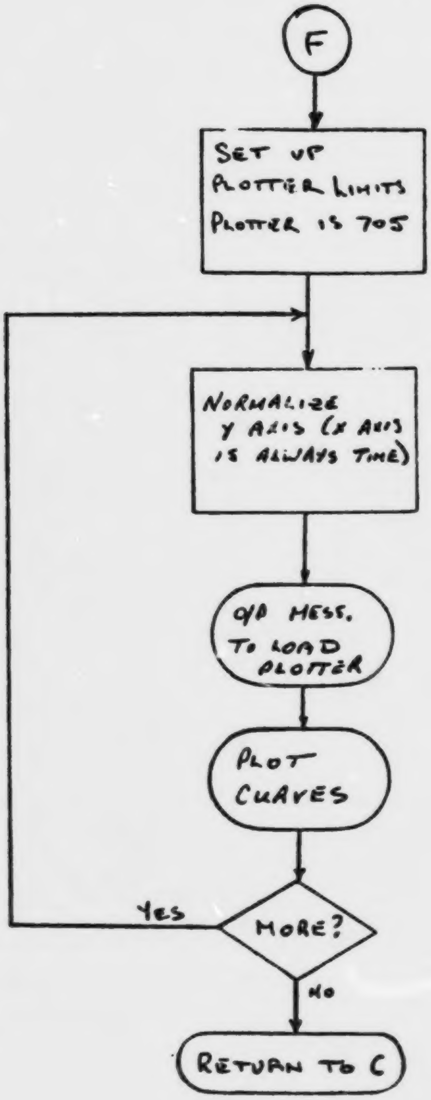

F
SET UP PLOTTER LIMITS PLOTTER IS 705
NORMALIZE Y AXIS (X AXIS IS ALWAYS TIME)
O/P MESS. TO LOAD PLOTTER
PLOT CURVES
MORE?
YES
NO
RETURN TO C

Figure G.9;
DATA CALCULATIONS AND OUTPUT

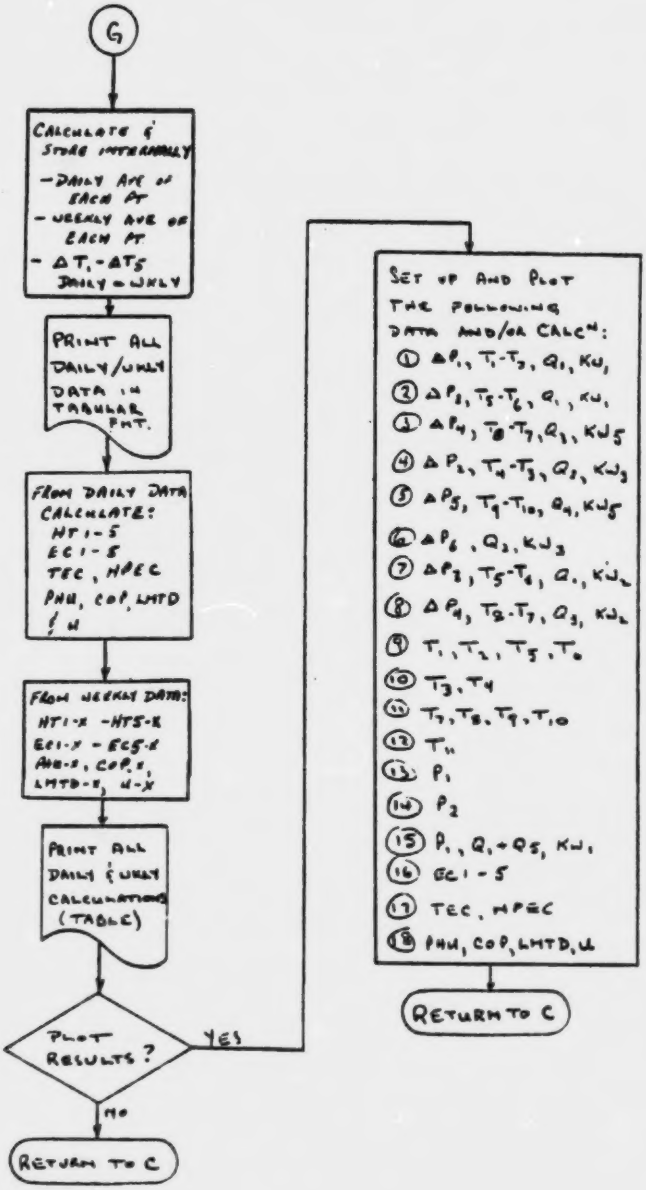
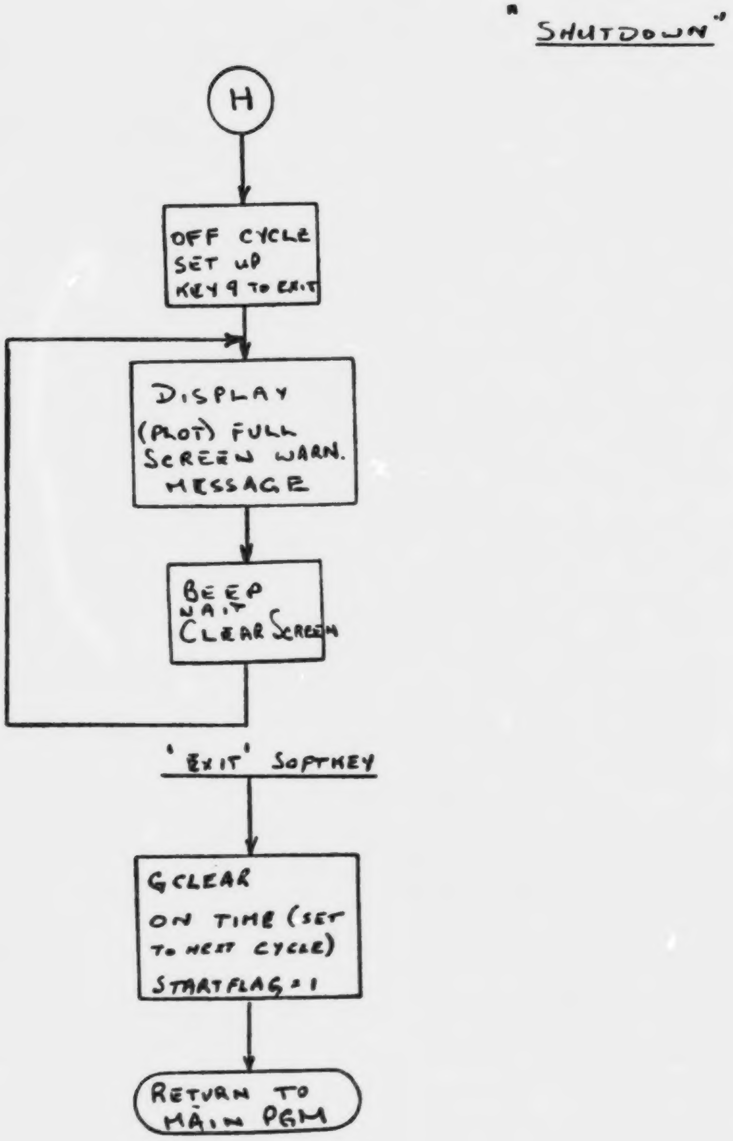

G
CALCULATE & STORE INTERNALLY
- DAILY AVE OF EACH PT
- WEEKLY AVE OF EACH PT.
- ΔT1 - ΔT5 DAILY & WKLY
PRINT ALL DAILY/WKLY DATA IN TABULAR FMT.
FROM DAILY DATA CALCULATE:
HT 1-5
EC 1-5
TEC, HPEC
PHM, COP, LMTD & U
FROM WEEKLY DATA:
HT1-X - HT5-X
EC1-X - EC5-X
PHM-X, COP-X,
LMTD-X, U-X
PRINT ALL DAILY & WKLY CALCULATIONS (TABLE)
PLOT RESULTS?
YES
NO
RETURN TO C
SET UP AND PLOT THE FOLLOWING DATA AND/OR CALCN:
① ΔP1, T1-T2, Q1, KW1
② ΔP2, T5-T6, Q1, KW1
③ ΔP4, T8-T7, Q3, KW5
④ ΔP2, T4-T3, Q2, KW3
⑤ ΔP5, T9-T10, Q4, KW5
⑥ ΔP6, Q2, KW3
⑦ ΔP3, T5-T6, Q1, KW2
⑧ ΔP4, T8-T7, Q3, KW2
⑨ T1, T2, T5, T6
⑩ T3, T4
⑪ T7, T8, T9, T10
⑫ T11
⑬ P1
⑭ P2
⑮ P1, Q1+Q5, KW1
⑯ EC1-5
⑰ TEC, HPEC
⑱ PHM, COP, LMTD, U
RETURN TO C

Figure G.10;
SHUTDOWN ROUTINE


"SHUTDOWN"
H
OFF CYCLE SET UP KEY 9 TO EXIT
DISPLAY (PLOT) FULL SCREEN WARN. MESSAGE
BEEP WAIT CLEAR SCREEN
'EXIT' SOFTKEY
GCLEAR
ON TIME (SET TO NEXT CYCLE)
STARTFLAG = 1
RETURN TO MAIN PGM

APPENDIX 'H' - MONITORED DATA AND PERFORMANCE RESULTS

Tables H-1 to H-49	- Monitored Data for Weekly Periods from April 27, 1985 to March 31, 1986.
Tables H-50 to H-97	- Calculated Performance Results for Weekly Periods from April 27, 1985 to March 31, 1986.

Table H-1; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 27 Apr 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	27 Apr	28 Apr	29 Apr	30 Apr	1 May	2 May	3 May	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	5.889	6.101	5.931	8.302	9.015	8.551	9.330	7.589
T2	5.781	6.076	5.902	7.643	8.190	8.682	9.012	7.327
T3	8.334	8.823	7.881	8.666	9.244	9.534	8.977	8.780
T4	7.436	8.147	7.471	8.644	8.866	9.369	8.820	8.393
T5	5.832	6.128	5.954	8.146	8.731	9.127	9.314	7.605
T6	5.753	6.135	5.908	8.382	9.087	9.339	9.403	7.715
T7	19.634	8.777	14.716	11.558	8.995	9.327	8.991	11.714
T8	22.352	9.694	16.072	13.257	9.624	9.642	9.187	12.833
T9	27.305	11.088	12.465	11.799	9.804	9.805	9.359	13.089
T10	25.392	11.133	11.779	14.754	9.979	9.571	9.046	13.094
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	.108	.026	.029	.659	.825	-.131	.318	.262
DT2	-.898	-.676	-.410	-.023	-.378	-.166	-.157	-.387
DT3	.079	-.006	.046	-.236	-.356	-.211	-.089	-.111
DT4	2.719	.917	1.355	1.699	.629	.315	.196	1.119
DT5	1.913	-.045	.686	-2.955	-.175	.234	.313	-.004
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	33.689	32.912	32.167	32.498	31.212	31.019	31.548	32.149
P3	17.323	26.613	29.368	32.700	35.120	35.341	33.830	30.042
DP1	77.711	77.431	78.234	.526	7.108	2.986	21.883	37.983
DP2	3.531	.213	3.138	.472	.442	.328	0.000	1.161
DP3	94.639	94.385	93.745	1.112	9.125	.809	1.365	42.168
DP4	1.599	.432	1.371	.412	.393	.407	.410	.718
DP5	1.530	1.048	1.004	.997	.953	.977	1.051	1.080
DP6	3.994	0.000	3.713	0.000	0.000	0.000	0.000	1.101
Q1	26.485	26.429	26.460	.059	2.303	.065	.052	11.693
Q2	1.218	0.000	1.192	0.000	0.000	0.000	0.000	.344
Q3	.508	.008	.430	.004	.006	.006	.005	.138
Q4	.130	.009	.218	.012	.006	.010	.007	.056
Q5	3.097	3.085	3.020	3.465	3.368	2.623	2.423	3.012
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	4.662	1.128	4.303	1.011	.821	1.110	1.003	2.005
KW3	.632	.090	.617	.078	.075	.088	.080	.237
KW4	.185	.115	.104	.110	.115	.136	.102	.124
KW5	.358	.075	.323	.072	.078	.081	.074	.151

Table H-2;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 4 May 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	4 May	5 May	6 May	7 May	8 May	9 May	10 May	
TOTAL HRS	24	24	24	24	24	24	18	162
HRS(T1-T4)	24	24	24	24	24	24	18	162
T1	8.760	8.705	7.039	7.225	7.212	7.359	7.390	7.680
T2	8.142	8.338	7.894	7.695	7.646	7.187	5.933	7.608
T3	8.399	8.314	8.018	7.698	7.541	8.180	4.336	7.615
T4	8.010	8.291	7.802	7.660	7.508	7.262	7.131	7.686
T5	8.807	8.905	8.598	8.407	8.374	7.819	5.959	8.204
T6	8.732	8.778	8.467	8.171	8.157	6.929	3.091	7.637
T7	8.156	8.225	7.944	7.625	7.540	18.643	50.323	14.204
T8	8.543	8.427	8.116	7.857	7.724	20.600	59.393	15.676
T9	8.553	8.511	8.238	7.901	7.803	18.731	60.218	15.541
T10	8.346	8.249	7.948	7.681	7.574	14.046	36.555	12.039
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	.618	.367	-.855	-.471	-.433	.172	1.457	.073
DT2	-.390	-.023	-.216	-.038	-.033	-.918	2.795	.071
DT3	.075	.126	.131	.236	.217	.889	2.868	.567
DT4	.388	.201	.173	.232	.184	1.957	9.070	1.472
DT5	.207	.262	.290	.220	.229	4.685	23.663	3.502
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	30.893	31.981	32.363	31.756	53.519	290.788	130.847	84.361
P3	33.695	34.392	34.947	34.788	33.433	45.436	274.432	62.595
DP1	26.787	26.046	11.605	10.466	14.951	13.795	73.135	23.482
DP2	0.000	0.000	0.000	0.000	0.000	.028	2.074	.235
DP3	1.437	1.418	.711	.382	.430	17.492	75.102	11.585
DP4	.435	.428	.448	.445	.449	8.305	33.343	5.261
DP5	1.071	1.063	1.075	1.131	1.087	7.139	28.516	5.030
DP6	0.000	0.000	0.000	0.000	0.000	28.505	202.079	26.676
Q1	.070	.058	.069	.083	.068	5.539	22.944	3.421
Q2	0.000	0.000	0.000	0.000	0.000	.516	12.546	1.470
Q3	.005	.004	.005	.003	.001	3.055	12.579	1.853
Q4	.005	.007	.008	.006	.006	1.072	4.898	.708
Q5	2.229	2.342	2.997	2.947	2.913	2.918	2.909	2.745
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	.974	1.095	.917	.943	.657	48.017	211.277	31.262
KW3	.074	.077	.077	.068	.057	.498	9.326	1.162
KW4	.077	.084	.078	.051	.030	.990	22.734	2.720
KW5	.065	.069	.070	.065	.056	1.669	6.603	1.029

CLEARWATER MONITORING SYSTEM

Table H-3; AVERAGE DATA FOR WEEK STARTING 11 May 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	11 May	12 May	13 May	14 May	15 May	16 May	17 May	
TOTAL HRS	24	24	22	24	24	24	24	166
HRS(T1-T4)	24	24	22	24	24	24	24	166
T1	7.352	6.678	6.599	5.892	6.911	7.525	6.992	6.853
T2	3.677	3.728	3.869	4.214	4.532	4.863	5.034	4.279
T3	2.414	2.722	2.958	3.507	3.590	3.817	4.227	3.324
T4	6.967	6.310	6.227	5.592	6.542	7.121	6.617.	6.485
T5	3.697	3.760	3.901	4.250	4.563	4.896	5.068	4.310
T6	1.596	2.281	2.592	3.322	3.049	3.562	3.757	2.883
T7	46.084	43.865	44.757	45.304	48.044	47.508	47.340	46.145
T8	52.162	47.876	48.514	48.675	53.750	52.661	52.432	50.896
T9	52.887	48.564	49.157	49.188	54.494	53.384	53.159	51.576
T10	28.609	22.476	23.181	24.105	30.723	29.708	30.002	27.018
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	3.675	2.951	2.731	1.678	2.379	2.662	1.958	2.574
DT2	4.553	3.587	3.269	2.085	2.952	3.304	2.390	3.162
DT3	2.100	1.478	1.309	.928	1.514	1.333	1.311	1.426
DT4	6.078	4.011	3.757	3.371	5.707	5.153	5.092	4.750
DT5	24.278	25.088	25.976	25.084	23.771	23.677	23.157	24.559
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	140.687	140.732	141.005	129.458	111.960	91.258	124.097	125.414
P3	250.318	250.537	230.554	222.786	233.949	234.582	233.818	236.722
DP1	57.442	57.064	62.928	84.106	86.763	87.053	90.257	75.234
DP2	19.937	20.515	29.110	52.962	56.556	57.099	57.419	42.097
DP3	57.005	55.675	62.766	94.965	95.684	95.383	94.531	79.631
DP4	28.834	26.098	26.024	25.702	29.093	27.915	28.001	27.397
DP5	13.238	5.159	4.263	4.421	11.980	9.487	8.944	8.261
DP6	202.407	202.463	176.753	147.490	153.814	152.706	151.414	169.492
Q1	19.494	19.357	20.501	26.117	26.346	26.297	26.237	23.514
Q2	17.761	18.061	19.511	23.790	24.877	24.745	24.849	21.972
Q3	11.486	10.834	10.845	10.536	11.605	11.338	11.338	11.144
Q4	2.162	.372	.351	.387	2.446	1.765	2.058	1.375
Q5	3.028	3.024	3.224	3.958	3.103	3.190	3.188	3.245
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	135.329	74.617	71.097	66.339	122.760	115.642	114.024	100.321
KW3	10.386	10.377	10.422	11.548	12.010	11.980	11.916	11.244
KW4	22.222	22.161	22.050	21.373	23.091	23.610	39.387	24.876
KW5	6.350	6.180	6.164	5.958	6.367	6.260	6.286	6.227

Table H-4;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 18 May 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	18 May	19 May	20 May	21 May	22 May	23 May	24 May	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	7.326	7.311	8.676	9.157	7.501	8.106	8.549	8.089
T2	5.170	5.242	5.637	5.675	4.805	4.890	5.095	5.216
T3	4.266	4.360	4.342	4.160	3.569	3.407	3.485	3.942
T4	6.905	6.876	8.103	8.475	6.888	7.360	7.749	7.482
T5	5.202	5.276	5.667	5.705	4.837	4.920	5.127	5.248
T6	3.620	3.842	3.539	3.261	2.613	2.673	2.737	3.183
T7	48.744	47.608	51.254	53.545	51.858	52.763	53.610	51.340
T8	54.601	52.965	58.793	62.044	59.760	60.598	61.877	58.663
T9	55.337	53.692	59.573	62.824	60.545	61.421	62.667	59.437
T10	33.365	31.704	39.834	44.291	41.338	42.326	44.322	39.597
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	2.156	2.069	3.040	3.481	2.696	3.216	3.454	2.873
DT2	2.639	2.516	3.761	4.315	3.318	3.973	4.264	3.541
DT3	1.583	1.434	2.127	2.444	2.224	2.248	2.390	2.064
DT4	5.858	5.357	7.539	8.499	7.902	7.836	8.267	7.322
DT5	21.972	21.988	19.739	18.533	19.207	19.094	18.345	19.840
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	134.562	134.754	108.373	100.273	93.016	90.394	86.885	106.897
P3	234.253	235.383	235.393	236.338	236.803	238.269	238.073	236.359
DP1	90.857	91.192	92.655	96.358	98.405	101.839	103.921	96.461
DP2	58.790	59.590	61.414	62.942	65.789	68.000	69.492	63.717
DP3	94.461	92.933	92.741	90.413	90.508	91.703	89.746	91.787
DP4	29.493	28.256	32.313	34.753	32.570	33.439	34.365	32.170
DP5	13.832	11.591	29.318	41.195	31.866	35.249	39.615	28.952
DP6	150.140	148.259	145.998	143.390	141.242	139.663	136.860	143.650
Q1	26.136	25.786	25.659	25.364	25.182	25.003	24.845	25.425
Q2	24.827	24.591	24.671	24.165	24.043	24.074	23.882	24.322
Q3	11.735	11.440	12.379	12.953	12.473	12.641	12.883	12.353
Q4	3.122	2.618	5.083	6.253	5.420	5.652	6.219	4.910
Q5	3.164	3.161	3.152	3.120	3.128	3.131	3.113	3.138
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	128.953	117.555	186.643	213.249	197.813	199.830	211.671	179.388
KW3	11.926	11.905	11.859	11.824	11.789	11.805	11.765	11.839
KW4	43.465	43.373	45.086	45.476	45.748	45.908	46.031	45.015
KW5	6.360	6.269	6.512	6.652	6.533	6.581	6.638	6.506

Table H-5; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 25 May 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	25 May	26 May	27 May	28 May	29 May	30 May	31 May	
TOTAL HRS	24	23	24	24	21	24	24	164
HRS(T1-T4)	24	23	24	24	21	24	24	164
T1	8.024	7.856	8.438	7.010	7.061	7.376	7.883	7.674
T2	4.864	4.505	4.908	4.663	5.107	5.140	5.196	4.911
T3	3.364	2.995	3.462	3.723	4.294	4.226	4.071	3.728
T4	7.226	6.937	6.970	6.265	6.327	6.526	6.998	6.757
T5	4.893	4.534	5.041	4.701	5.146	5.174	5.233	4.960
T6	2.324	2.010	2.915	2.541	3.227	2.943	2.756	2.667
T7	49.914	50.491	44.602	45.217	48.255	51.958	49.685	48.584
T8	58.151	58.565	50.280	51.383	53.774	58.645	56.936	55.401
T9	58.879	59.308	50.916	52.115	54.245	59.097	57.715	56.052
T10	43.961	44.645	35.423	34.678	38.834	44.301	43.752	40.812
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	3.161	3.351	3.530	2.347	1.954	2.236	2.687	2.763
DT2	3.862	3.943	3.508	2.543	2.033	2.300	2.928	3.029
DT3	2.569	2.525	2.126	2.160	1.920	2.232	2.478	2.292
DT4	8.237	8.073	5.677	6.166	5.518	6.687	7.251	6.817
DT5	14.918	14.663	15.494	17.437	15.411	14.796	13.963	15.241
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	84.657	82.423	111.195	122.213	119.140	118.638	114.158	107.429
P3	238.687	231.620	229.060	238.232	199.334	177.258	209.071	217.858
DP1	107.093	111.310	61.085	89.418	94.983	94.678	104.073	94.556
DP2	72.737	79.474	39.315	79.539	90.282	93.434	93.642	78.121
DP3	87.863	86.847	47.871	71.998	76.163	76.206	82.256	75.522
DP4	38.281	38.129	32.490	32.510	33.412	36.180	37.095	35.463
DP5	62.376	63.310	30.198	24.295	34.321	55.732	55.608	46.670
DP6	134.245	117.870	151.103	124.223	72.561	43.752	80.862	103.995
Q1	24.564	24.237	18.840	27.245	28.209	27.558	29.073	25.637
Q2	23.685	24.272	14.859	23.636	24.386	24.235	24.430	22.748
Q3	13.602	13.563	12.261	12.281	12.500	13.159	13.324	12.960
Q4	7.984	8.011	4.590	4.635	5.391	7.093	7.447	6.460
Q5	3.088	3.082	2.162	4.679	3.368	3.197	2.384	3.133
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	207.045	206.859	129.909	131.918	128.964	186.505	180.111	167.791
KW3	11.776	11.906	8.762	11.470	11.354	10.908	11.537	11.092
KW4	46.142	46.239	60.709	50.187	44.044	44.128	44.517	48.078
KW5	6.820	6.814	6.515	6.542	6.585	6.733	6.784	6.686

Table H-6;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 1 Jun 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	1 Jun	2 Jun	3 Jun	4 Jun	5 Jun	6 Jun	7 Jun	
TOTAL HRS	8	0	21	24	24	11	23	111
HRS(T1-T4)	8	0	21	24	24	11	23	111
T1	7.955	0.000	8.146	8.043	7.377	7.296	7.681	7.763
T2	5.162	0.000	5.333	5.713	5.156	4.978	5.406	5.344
T3	4.274	0.000	4.373	4.327	4.251	4.000	4.345	4.287
T4	6.882	0.000	7.116	7.353	6.541	6.429	6.779	6.888
T5	5.199	0.000	5.368	5.751	5.190	5.007	5.440	5.379
T6	3.120	0.000	2.411	2.858	2.375	2.218	2.945	2.643
T7	54.233	0.000	53.352	46.353	52.528	53.058	52.937	51.609
T8	60.487	0.000	61.077	53.758	60.343	60.900	59.915	59.025
T9	61.158	0.000	61.873	54.520	61.135	61.580	60.705	59.801
T10	47.229	0.000	47.810	40.972	46.921	47.499	47.774	46.059
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	2.793	0.000	2.813	2.330	2.221	2.319	2.275	2.419
DT2	2.608	0.000	2.743	3.027	2.290	2.429	2.434	2.601
DT3	2.079	0.000	2.957	2.893	2.815	2.789	2.494	2.737
DT4	6.254	0.000	7.725	7.405	7.815	7.742	6.979	7.416
DT5	13.931	0.000	14.062	13.548	14.215	14.082	12.931	13.742
F1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F2	112.073	0.000	111.103	108.098	107.076	114.809	127.983	113.517
F3	186.257	0.000	211.040	242.906	212.481	212.229	197.670	213.803
DP1	99.440	0.000	89.336	95.880	102.385	104.456	112.286	100.554
DP2	107.934	0.000	100.349	67.353	105.643	106.150	106.747	96.807
DP3	79.068	0.000	65.997	68.432	73.655	74.235	75.244	71.854
DP4	36.053	0.000	38.434	38.472	38.547	38.526	37.946	38.203
DP5	55.688	0.000	65.078	60.835	64.527	64.501	60.625	62.385
DP6	29.448	0.000	77.827	153.034	73.833	72.897	51.843	83.865
C1	28.268	0.000	25.523	26.059	27.093	26.990	27.351	26.700
C2	27.299	0.000	23.999	18.826	23.875	23.675	23.073	22.868
C3	13.143	0.000	13.647	13.508	13.684	13.659	13.516	13.563
C4	7.169	0.000	8.077	7.684	8.133	8.122	7.520	7.828
C5	2.704	0.000	3.159	2.931	2.735	2.633	3.310	2.964
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	176.805	0.000	203.448	189.766	208.283	208.926	193.851	198.169
KW3	12.006	0.000	11.404	10.392	11.402	11.325	10.947	11.126
KW4	44.741	0.000	44.492	44.660	44.684	51.893	64.562	49.480
KW5	6.741	0.000	6.756	6.746	6.786	6.784	6.747	6.760

TAble H-7; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 8 Jun 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	8 Jun	9 Jun	10 Jun	11 Jun	12 Jun	13 Jun	14 Jun	
TOTAL HRS	9	18	24	24	24	24	24	147
HRS(T1-T4)	9	18	24	24	24	24	24	147
T1	8.190	7.790	7.959	8.666	8.537	8.424	8.928	8.396
T2	5.557	5.680	5.737	5.956	5.961	6.437	6.146	5.973
T3	4.378	4.548	4.559	4.749	4.821	4.784	4.851	4.705
T4	7.181	6.995	7.108	7.520	7.412	7.790	7.763	7.434
T5	5.587	5.708	5.769	5.993	5.994	6.473	6.180	6.006
T6	2.973	2.991	3.080	3.397	3.274	3.240	3.014	3.161
T7	56.865	54.424	55.727	56.930	57.056	46.958	50.811	53.816
T8	64.418	62.240	63.423	64.124	64.508	55.439	58.861	61.582
T9	65.218	63.022	64.225	64.959	65.338	56.168	59.627	62.374
T10	51.446	48.866	50.215	53.530	54.737	43.274	47.599	49.845
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	2.632	2.110	2.222	2.710	2.576	1.987	2.782	2.424
DT2	2.803	2.447	2.548	2.771	2.591	3.005	2.911	2.729
DT3	2.614	2.717	2.689	2.596	2.720	3.233	3.166	2.845
DT4	7.553	7.815	7.697	7.194	7.453	8.481	8.050	7.766
DT5	13.772	14.156	14.009	11.429	10.601	12.893	12.028	12.529
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	127.533	127.431	124.841	124.513	101.683	117.422	120.052	119.495
P3	206.984	223.909	221.835	201.610	199.692	253.397	216.947	218.617
DP1	116.231	120.084	119.642	121.649	123.754	126.126	118.973	121.436
DP2	112.329	104.296	108.606	128.037	150.842	78.353	134.748	117.703
DP3	76.544	76.151	76.370	74.762	73.873	73.090	66.200	73.488
DP4	38.080	38.200	38.332	38.824	39.216	39.829	39.574	38.972
DP5	64.998	64.532	63.667	62.030	62.500	64.398	62.350	63.301
DP6	53.103	88.372	80.483	22.912	12.907	155.563	52.979	67.108
Q1	27.649	27.489	27.300	27.027	26.847	26.594	25.238	26.774
Q2	23.878	21.879	21.868	24.478	24.892	16.680	22.616	22.188
Q3	13.702	13.681	13.699	13.795	13.881	13.832	13.843	13.787
Q4	8.171	8.113	8.115	8.083	7.951	7.910	8.005	8.035
Q5	3.667	3.776	3.607	5.161	6.306	6.065	6.018	5.122
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	214.418	213.263	210.678	203.717	211.381	206.199	208.364	209.093
KW3	11.323	10.978	10.996	11.479	11.530	9.880	11.093	11.013
KW4	64.430	64.533	64.752	64.728	46.278	61.511	64.815	61.167
KW5	6.764	6.781	6.764	6.772	6.820	6.827	6.825	6.797

Table H-8;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 15 Jun 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	15 Jun	16 Jun	17 Jun	18 Jun	19 Jun	20 Jun	21 Jun	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	9.416	9.503	9.331	8.840	8.780	9.291	9.171	9.190
T2	6.199	6.064	6.050	6.369	6.243	6.300	6.874	6.300
T3	4.753	4.632	4.622	4.797	5.008	4.978	5.266	4.865
T4	8.110	8.117	7.996	7.942	7.684	8.022	8.259	8.019
T5	6.231	6.093	6.078	6.396	6.275	6.329	6.901	6.329
T6	2.752	2.334	2.371	2.754	2.750	2.602	3.453	2.717
T7	48.726	47.927	48.466	44.634	48.680	49.102	49.189	48.103
T8	56.901	56.068	56.573	52.440	56.782	57.133	57.450	56.192
T9	57.631	56.786	57.294	53.134	57.547	57.872	58.176	56.920
T10	45.278	44.423	45.007	41.091	45.565	46.014	45.931	44.758
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	3.217	3.439	3.282	2.471	2.537	2.991	2.297	2.891
DT2	3.357	3.485	3.374	3.145	2.676	3.045	2.993	3.153
DT3	3.479	3.758	3.707	3.642	3.525	3.726	3.448	3.612
DT4	8.175	8.141	8.106	7.806	8.102	8.031	8.260	8.089
DT5	12.353	12.363	12.287	12.043	11.982	11.858	12.246	12.162
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	118.197	117.993	114.917	128.465	134.697	139.208	140.192	127.667
P3	226.208	234.644	235.909	252.931	230.659	235.557	248.364	237.753
DP1	110.039	94.940	97.046	111.131	111.476	97.326	123.860	106.546
DP2	128.058	122.196	126.676	100.039	147.639	149.513	129.793	129.131
DP3	60.006	50.207	50.183	58.621	58.814	49.697	61.824	55.622
DP4	39.776	39.727	39.688	39.479	40.027	39.860	39.667	39.746
DP5	62.758	62.385	62.792	58.993	63.273	62.912	62.202	62.189
DP6	70.396	87.240	84.535	131.232	56.413	59.894	95.729	83.634
Q1	23.680	21.536	21.442	22.657	23.098	21.274	23.787	22.496
Q2	21.425	19.823	19.497	16.282	20.343	19.509	17.078	19.137
Q3	13.840	13.843	13.827	13.724	13.900	13.890	13.863	13.841
Q4	7.960	7.955	7.977	7.676	7.893	7.956	7.931	7.907
Q5	6.099	5.990	6.004	5.791	5.940	5.907	5.924	5.951
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	205.956	203.228	206.253	186.780	206.697	204.394	208.889	203.171
KW3	10.865	10.586	10.520	9.803	10.659	10.508	10.004	10.421
KW4	64.964	64.888	65.179	63.593	62.785	62.106	61.996	63.644
KW5	6.821	6.824	6.821	6.798	6.819	6.923	6.826	6.819

TAble H-9; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 22 Jun 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	22 Jun	23 Jun	24 Jun	25 Jun	26 Jun	27 Jun	28 Jun	
TOTAL HRS	23	24	24	24	24	24	24	167
HRS(T1-T4)	23	24	24	24	24	24	24	167
T1	9.499	8.886	9.010	8.845	8.736	8.358	8.374	8.811
T2	6.749	6.563	6.754	6.970	5.917	5.759	5.774	6.353
T3	5.467	5.497	5.547	5.304	4.939	4.690	4.674	5.158
T4	8.295	7.845	8.357	8.424	7.927	7.601	7.568	8.001
T5	6.773	6.567	6.416	6.077	5.946	5.786	5.799	6.194
T6	3.300	2.914	3.185	2.486	1.863	1.853	2.268	2.548
T7	52.434	51.735	44.841	43.154	44.558	45.044	47.891	47.062
T8	60.358	59.615	52.221	51.295	52.677	53.176	55.847	54.995
T9	61.100	60.353	52.909	51.974	53.374	53.876	56.565	55.704
T10	49.553	48.801	41.628	39.638	41.153	41.663	44.815	43.859
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	2.750	2.323	2.256	1.876	2.819	2.599	2.600	2.459
DT2	2.828	2.348	2.810	3.120	2.987	2.911	2.894	2.843
DT3	3.474	3.673	3.231	3.591	4.082	3.934	3.531	3.646
DT4	7.924	7.881	7.380	8.141	8.119	8.132	7.957	7.933
DT5	11.547	11.552	11.281	12.336	12.221	12.213	11.750	11.845
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	140.322	140.332	138.785	137.521	137.767	138.114	136.946	138.530
P3	233.077	240.935	229.708	248.810	246.824	248.673	239.097	241.065
DP1	109.381	102.922	87.323	66.715	77.181	83.933	95.786	88.913
DP2	171.900	174.206	117.425	89.145	109.168	111.637	130.939	128.947
DP3	53.548	48.195	58.668	61.647	46.232	49.525	56.415	53.461
DP4	39.484	39.505	39.371	40.450	40.602	40.546	40.248	40.033
DP5	61.442	61.946	55.888	61.844	61.705	61.889	61.346	60.862
DP6	33.786	41.499	80.755	127.098	113.782	113.197	74.438	83.806
Q1	21.966	20.888	20.617	16.871	20.190	20.862	22.297	20.519
Q2	19.906	19.824	21.243	21.903	18.488	17.942	19.571	19.839
Q3	13.883	13.862	13.668	13.847	13.905	13.930	13.931	13.861
Q4	7.953	7.934	7.128	7.825	7.951	7.885	7.841	7.787
Q5	5.908	5.856	6.025	5.909	6.157	6.109	5.916	5.993
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	209.031	207.879	181.513	193.517	195.966	200.232	201.080	198.397
KW3	10.506	10.843	11.102	13.004	10.508	10.424	10.711	11.031
KW4	61.881	61.919	62.086	62.324	62.313	62.267	62.459	62.180
KW5	6.824	6.822	6.783	6.845	6.847	6.861	6.853	6.834

Table H-10;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 29 Jun 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	29 Jun	30 Jun	1 Jul	2 Jul	3 Jul	4 Jul	5 Jul	
TOTAL HRS	24	23	24	24	23	24	22	164
HRS(T1-T4)	24	23	24	24	23	24	22	164
T1	8.660	8.814	9.452	9.743	10.275	10.452	10.532	9.696
T2	5.869	5.943	6.298	6.393	6.515	6.694	7.069	6.391
T3	4.646	4.682	4.845	5.081	5.148	5.249	5.469	5.013
T4	7.806	7.903	8.464	8.647	9.056	9.244	9.521	8.655
T5	5.895	5.968	6.322	6.417	6.540	6.716	7.073	6.413
T6	2.271	2.364	2.765	2.329	2.074	2.281	3.527	2.507
T7	47.584	49.136	50.555	50.079	49.124	49.985	52.319	49.804
T8	55.583	57.013	58.405	57.850	56.887	57.764	59.725	57.586
T9	56.296	57.725	59.132	58.579	57.605	58.471	60.470	58.307
T10	44.423	46.126	47.633	47.151	46.085	47.003	49.627	46.840
T11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DT1	2.790	2.871	3.154	3.350	3.760	3.758	3.464	3.305
DT2	3.160	3.221	3.619	3.566	3.908	3.995	4.052	3.642
DT3	3.624	3.604	3.557	4.089	4.466	4.435	3.546	3.906
DT4	7.998	7.877	7.850	7.771	7.763	7.779	7.406	7.782
DT5	11.873	11.600	11.499	11.427	11.520	11.468	10.844	11.468
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	136.530	136.562	136.618	137.663	137.320	138.099	137.743	137.216
P3	244.591	242.883	245.127	250.760	256.915	258.582	243.229	248.926
DP1	92.533	94.269	95.795	77.067	65.826	67.623	85.727	82.687
DP2	130.610	141.012	145.993	144.594	139.139	142.986	165.482	144.052
DP3	53.181	51.951	52.218	41.550	34.872	34.631	50.564	45.532
DP4	40.361	40.181	40.029	40.031	40.088	39.975	40.023	40.099
DP5	61.146	60.978	60.954	61.548	61.860	61.107	60.795	61.200
DP6	84.355	68.722	65.812	77.096	93.404	90.363	48.854	75.773
Q1	21.620	21.493	21.364	18.698	16.980	16.935	20.184	19.608
Q2	18.570	18.757	18.183	16.970	15.767	15.091	16.957	17.187
Q3	13.925	13.934	13.948	13.950	13.918	13.954	13.960	13.941
Q4	7.836	7.824	7.822	7.737	7.740	7.732	7.590	7.756
Q5	5.934	6.057	6.068	5.770	5.874	5.826	5.655	5.885
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	200.682	201.550	206.610	201.521	201.551	201.746	198.506	201.780
KW3	10.505	10.525	10.467	10.238	9.950	9.869	10.951	10.352
KW4	62.516	62.414	62.570	62.530	62.391	62.274	62.325	62.433
KW5	6.871	6.863	6.876	6.865	6.853	6.849	6.941	6.873

TAble H-11;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 6 Jul 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	6 Jul	7 Jul	8 Jul	9 Jul	10 Jul	11 Jul	12 Jul	
TOTAL HRS	21	22	24	24	23	24	23	161
HRS(T1-T4)	21	22	24	24	23	24	23	161
T1	11.401	10.978	11.066	11.240	11.394	11.556	11.256	11.270
T3	6.397	5.979	5.917	5.976	6.084	6.287	6.354	6.138
T4	10.443	10.001	9.974	10.100	10.370	10.332	10.083	10.183
T5	7.903	7.376	7.291	7.434	7.456	7.730	7.696	7.551
T6	4.106	2.903	2.591	2.854	3.076	3.007	2.892	3.045
T7	49.364	47.590	48.910	51.432	50.673	50.802	51.432	50.059
T8	56.819	55.209	56.622	59.164	58.549	58.662	59.161	57.776
T10	46.932	44.743	46.098	48.675	47.724	47.864	48.604	47.246
T11	0.000	2.963	4.927	5.013	5.175	5.413	5.468	4.214
DT1	3.498	3.602	3.774	3.806	3.938	3.826	3.560	3.720
DT2	4.047	4.021	4.058	4.125	4.286	4.045	3.729	4.045
DT3	3.796	4.473	4.700	4.580	4.380	4.723	4.804	4.506
DT4	7.455	7.619	7.712	7.732	7.876	7.860	7.729	7.717
DT5	9.987	10.467	10.524	10.489	10.825	10.798	10.557	10.529
P1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P2	137.178	137.710	137.637	141.219	142.763	143.200	142.710	140.407
P3	237.062	263.232	262.558	260.258	255.002	262.134	263.389	257.958
DP1	61.025	59.646	55.433	60.219	58.387	59.289	57.306	58.716
DP2	129.030	137.330	146.242	162.754	165.210	182.599	188.553	159.414
DP3	35.938	34.698	31.635	33.357	37.914	31.249	30.685	33.575
DP4	36.174	39.834	40.160	40.019	39.970	39.955	39.853	39.473
DP5	55.134	59.550	61.985	60.890	61.970	61.323	61.127	60.372
DP6	87.537	109.052	98.845	77.668	68.374	58.771	54.037	78.880
Q1	16.525	16.863	16.184	16.700	15.598	16.104	15.679	16.230
Q2	13.794	14.301	14.280	14.447	15.091	13.329	13.719	14.138
Q3	12.620	13.824	13.939	13.949	13.926	13.945	13.933	13.751
Q4	7.084	7.440	7.744	7.728	7.680	7.707	7.765	7.602
Q5	5.338	5.635	5.678	5.907	5.923	6.246	6.299	5.870
KW1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KW2	181.459	194.008	198.384	204.035	205.563	206.410	205.620	199.677
KW3	8.915	9.667	9.679	9.769	10.005	9.731	9.548	9.641
KW4	81.725	83.472	83.434	69.336	62.196	62.148	62.190	71.873
KW5	6.219	6.822	6.852	6.834	6.831	6.846	6.828	6.755

TAble H-12; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 13 Jul 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	13 Jul	14 Jul	15 Jul	16 Jul	17 Jul	18 Jul	19 Jul	
TOTAL HRS	24	24	24	24	22	24	24	166
HRS(T1-T4)	24	24	24	24	22	24	24	166
T1	11.318	11.508	11.919	11.667	11.565	10.924	10.440	11.332
T3	6.504	6.666	10.542	8.441	7.724	7.365	6.599	7.691
T4	10.181	10.390	11.756	11.733	11.019	10.368	9.818	10.749
T5	7.870	8.111	11.650	9.314	8.523	7.946	7.206	8.662
T6	3.138	3.423	8.569	6.055	4.557	4.210	3.557	4.790
T7	52.841	54.130	35.616	38.711	45.745	44.179	48.709	45.704
T8	60.555	61.790	39.988	45.203	54.282	52.314	57.290	53.046
T10	50.125	51.524	34.451	35.284	41.886	40.318	44.414	42.580
T11	5.588	5.805	6.406	6.853	6.682	6.212	5.707	6.173
DT1	3.448	3.397	.269	2.353	3.043	2.978	3.234	2.670
DT2	3.677	3.724	1.214	3.293	3.295	3.003	3.219	3.058
DT3	4.732	4.688	3.081	3.260	3.966	3.736	3.649	3.872
DT4	7.714	7.660	4.372	6.492	8.538	8.135	8.580	7.342
DT5	10.430	10.266	5.536	9.919	12.396	11.996	12.876	10.465
P1	0.000	0.000	0.000	0.000	0.000	0.000	157.921	22.832
P2	142.282	142.636	141.747	141.073	136.503	133.918	133.227	138.797
P3	264.530	266.560	200.910	199.631	223.137	217.475	212.887	226.487
DP1	60.525	61.598	31.146	18.431	13.015	31.666	49.704	38.313
DP2	194.775	198.993	80.633	52.793	31.406	32.123	54.058	92.843
DP3	30.613	30.133	28.305	17.256	49.354	45.491	56.322	36.630
DP4	39.645	39.478	16.563	33.315	40.119	40.159	40.466	35.624
DP5	61.271	60.648	26.121	50.669	59.992	56.011	60.575	53.825
DP6	46.525	43.662	57.543	134.578	167.564	162.050	128.454	105.023
Q1	15.674	15.604	8.665	7.768	22.051	20.620	24.373	16.325
Q2	13.737	13.194	6.881	15.633	19.192	18.077	23.226	15.664
Q3	13.926	13.928	5.810	11.416	13.858	13.813	13.977	12.372
Q4	7.913	7.739	3.366	5.813	7.562	7.135	7.671	6.718
Q5	5.933	5.905	4.633	4.697	3.530	3.817	4.107	4.674
KW1	0.000	0.000	0.000	0.000	23.162	56.927	71.047	21.572
KW2	203.707	206.943	86.196	143.595	205.014	191.971	212.012	178.171
KW3	9.595	9.464	5.259	10.232	10.304	9.815	11.361	9.422
KW4	62.271	62.151	62.274	62.315	62.933	63.104	63.095	62.588
KW5	6.911	6.812	2.932	5.698	6.810	6.817	6.847	6.095

CLEARWATER MONITORING SYSTEM
Table H-13; AVERAGE DATA FOR WEEK STARTING 20 Jul 1995

DAY	1	2	3	4	5	6	7	WEEK
DATE	20 Jul	21 Jul	22 Jul	23 Jul	24 Jul	25 Jul	25 Jul	
TOTAL HRS	22	24	22	23	23	24	24	162
HRS(T1-T4)	22	24	22	23	23	24	24	162
T1	10.738	10.294	9.590	9.332	9.782	10.283	10.498	10.078
T3	6.180	6.011	5.837	5.435	5.186	5.115	5.205	5.559
T4	10.036	9.665	8.967	8.672	9.010	9.417	9.595	9.339
T5	6.935	6.853	6.564	6.220	6.127	6.196	6.336	6.458
T6	3.299	3.425	2.904	2.548	2.486	2.669	2.732	2.865
T7	48.617	48.030	47.277	46.799	47.043	47.434	48.194	47.628
T8	57.196	56.254	55.785	55.311	55.458	55.708	56.567	56.037
T10	44.617	44.240	43.605	43.299	43.529	43.891	44.622	43.975
T11	5.342	5.110	5.002	4.615	4.377	4.329	4.408	4.733
DT1	3.204	3.441	3.026	3.111	3.655	4.087	4.163	3.620
DT2	3.856	3.654	3.130	3.237	3.825	4.301	4.390	3.780
DT3	3.636	3.428	3.660	3.672	3.641	3.527	3.604	3.593
DT4	8.580	8.224	8.507	8.513	8.415	8.274	8.372	8.408
DT5	12.579	12.014	12.180	12.013	11.929	11.816	11.945	12.061
P1	284.312	285.370	286.625	287.472	286.756	286.082	286.943	286.230
P2	133.974	134.088	134.538	134.330	134.521	136.283	136.863	134.966
P3	215.059	208.181	219.138	220.430	221.458	221.571	222.623	218.350
DP1	55.724	57.098	50.310	44.231	44.174	45.002	46.051	48.899
DP2	60.995	63.584	71.234	75.070	76.691	81.609	84.945	73.599
DP3	56.571	57.039	56.995	56.208	54.947	55.298	55.369	56.049
DP4	40.267	40.011	40.422	40.433	40.688	40.629	40.574	40.433
DP5	60.844	59.941	61.586	61.492	61.254	61.506	60.765	61.047
DP6	125.740	117.579	120.456	117.788	116.089	112.920	110.617	117.174
Q1	24.250	24.334	24.240	24.163	23.975	23.958	23.986	24.113
Q2	22.820	21.582	22.184	21.843	21.663	21.790	21.512	21.901
Q3	13.975	13.895	13.973	13.929	13.987	13.999	13.998	13.965
Q4	7.750	7.425	7.895	7.603	7.458	7.385	7.673	7.594
Q5	4.315	4.316	5.142	5.720	5.527	5.594	4.780	5.057
KW1	69.478	69.443	69.644	69.563	69.504	69.706	69.679	69.575
KW2	210.545	199.872	208.105	207.236	209.207	205.255	206.877	206.646
KW3	11.277	10.740	11.180	11.112	11.074	11.097	11.060	11.073
KW4	63.131	63.032	62.976	63.000	63.025	63.844	63.214	63.180
KW5	6.850	6.837	6.851	6.836	6.851	6.851	6.867	6.849

Table H-14; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 27 Jul 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	27 Jul	28 Jul	29 Jul	30 Jul	31 Jul	1 Aug	2 Aug	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	10.669	10.714	10.294	10.052	10.201	9.707	9.779	10.202
T3	5.361	5.445	5.578	5.589	5.704	5.715	5.696	5.584
T4	9.758	9.802	9.444	9.214	9.363	8.942	8.997	9.360
T5	6.557	6.705	6.772	6.783	6.935	6.863	6.882	6.785
T6	2.930	3.097	3.164	3.162	3.309	3.220	3.189	3.153
T7	49.096	49.682	49.626	49.844	50.208	50.305	50.438	49.885
T8	57.504	58.112	58.042	58.229	58.599	58.725	58.773	58.283
T10	45.485	46.076	46.051	46.276	46.648	46.732	46.871	46.306
T11	4.576	4.660	4.786	4.812	4.916	4.934	4.907	4.799
DT1	4.112	4.009	3.522	3.269	3.266	2.844	2.897	3.417
DT2	4.397	4.358	3.866	3.626	3.658	3.226	3.301	3.776
DT3	3.628	3.607	3.608	3.621	3.626	3.643	3.693	3.532
DT4	8.408	8.430	8.416	8.385	8.390	8.420	8.336	8.398
DT5	12.019	12.036	11.991	11.953	11.950	11.993	11.902	11.978
P1	287.424	287.272	287.514	287.708	287.279	288.081	288.607	287.698
P2	137.351	138.062	138.018	138.573	139.407	140.095	140.225	138.819
P3	224.623	226.916	228.915	231.490	233.326	235.378	237.282	231.133
DP1	46.986	48.252	49.377	50.053	51.417	53.408	54.336	50.547
DP2	88.952	93.619	99.843	106.028	109.925	113.684	119.751	104.543
DP3	55.572	55.785	55.317	54.690	54.353	54.470	53.589	54.825
DP4	40.344	40.295	40.295	40.277	40.155	39.976	40.094	40.205
DP5	60.772	61.037	61.259	61.225	60.826	61.365	61.033	61.074
DP6	107.652	104.990	101.713	98.388	96.472	94.087	91.971	99.325
Q1	23.910	23.853	23.761	23.700	23.522	23.490	23.283	23.645
Q2	21.353	20.993	20.570	20.131	19.840	19.529	19.277	20.242
Q3	13.991	13.963	13.983	14.006	13.942	13.976	13.954	13.974
Q4	7.781	7.739	7.648	7.721	7.714	7.768	7.727	7.728
Q5	4.190	4.171	4.455	5.323	5.324	5.302	5.060	4.832
KW1	69.800	69.873	69.925	69.894	69.907	69.990	69.896	69.864
KW2	210.456	210.940	212.861	213.090	212.523	210.456	212.153	211.783
KW3	11.025	10.943	10.895	10.807	10.761	10.686	10.633	10.821
KW4	63.223	63.140	63.097	63.070	63.039	62.915	62.895	63.054
KW5	6.864	6.875	6.853	6.840	6.842	6.850	6.837	6.851

Table H-15; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 3 Aug 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	3 Aug	4 Aug	5 Aug	6 Aug	6 Aug	7 Aug	8 Aug	
TOTAL HRS	23	24	24	23	24	24	24	166
HRS(T1-T4)	23	24	24	23	24	24	24	166
T1	9.556	9.963	10.620	10.958	11.246	11.436	11.362	10.740
T3	5.674	5.722	5.942	5.915	5.639	5.675	5.694	5.751
T4	8.799	9.129	9.623	10.618	10.627	10.783	10.596	10.029
T5	6.840	7.058	7.267	6.582	6.618	6.722	6.647	6.820
T6	3.177	3.399	3.713	3.288	3.321	3.432	3.397	3.391
T7	50.659	51.535	54.073	48.566	49.312	49.718	50.139	50.583
T8	59.029	59.870	62.172	56.887	57.692	58.089	58.467	58.898
T10	47.086	47.945	50.734	44.379	44.593	45.065	45.657	46.503
T11	4.875	4.930	5.174	5.107	4.829	4.853	4.869	4.948
DT1	2.716	2.905	3.353	4.376	4.628	4.714	4.715	3.920
DT2	3.125	3.406	3.681	4.703	4.988	5.109	4.902	4.278
DT3	3.663	3.660	3.554	3.294	3.298	3.290	3.250	3.429
DT4	8.370	8.335	8.098	8.321	8.381	8.371	8.328	8.315
DT5	11.944	11.926	11.438	12.508	13.099	13.025	12.810	12.395
P1	287.577	288.298	289.015	295.203	280.954	281.163	281.814	286.228
P2	140.725	140.568	141.418	141.606	142.997	143.881	143.884	142.166
P3	239.043	241.723	234.461	188.110	213.366	216.248	207.917	220.203
DP1	56.291	58.705	60.995	32.974	51.096	52.095	52.077	52.123
DP2	124.027	130.245	143.717	60.291	48.102	47.813	54.465	86.889
DP3	53.374	52.413	52.092	69.846	67.305	67.125	68.079	61.460
DP4	39.974	39.870	39.682	40.157	40.851	40.705	40.565	40.260
DP5	61.318	61.798	61.367	60.956	60.855	60.950	59.981	61.037
DP6	89.542	85.804	59.084	66.360	133.917	137.606	119.844	99.132
Q1	23.143	23.010	22.833	13.564	26.337	26.253	26.228	23.109
Q2	18.921	18.506	19.516	25.287	22.983	22.748	23.748	21.667
Q3	13.959	13.957	13.960	13.911	14.080	14.060	14.014	13.992
Q4	7.805	7.791	7.840	7.212	7.670	7.672	7.620	7.660
Q5	5.213	5.169	4.962	5.056	3.794	3.677	3.633	4.493
KW1	69.844	69.725	69.668	69.351	60.121	60.102	56.783	65.030
KW2	213.221	213.006	217.505	211.737	211.011	211.195	213.297	213.002
KW3	10.564	10.465	10.696	11.749	11.381	11.427	11.585	11.124
KW4	62.724	62.657	62.547	62.366	62.318	62.134	62.044	62.397
KW5	6.837	6.852	6.827	6.820	6.873	6.877	6.863	6.850

Table H-16;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 10 Aug 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	9 Aug	10 Aug	11 Aug	12 Aug	13 Aug	14 Aug	15 Aug	
TOTAL HRS	24	24	24	22	24	24	19	161
HRS(T1-T4)	24	24	24	22	24	24	19	161
T1	11.350	11.439	11.135	11.651	11.941	11.432	11.403	11.479
T3	5.671	5.938	5.886	6.192	6.074	6.133	6.328	6.021
T4	10.494	10.571	10.215	10.575	10.771	10.502	10.532	10.522
T5	6.596	7.057	6.815	7.082	7.143	7.469	7.679	7.103
T6	3.568	4.119	3.729	3.984	3.688	4.143	3.955	3.880
T7	50.462	49.118	50.057	48.014	50.813	51.957	49.839	50.068
T8	58.536	56.830	57.999	55.321	58.811	60.371	58.184	58.035
T10	45.969	44.954	45.637	43.736	46.096	46.969	44.819	45.495
T11	4.844	5.030	5.080	5.223	5.267	5.306	5.480	5.166
DT1	4.755	4.382	4.320	4.569	4.798	3.963	3.725	4.376
DT2	4.823	4.633	4.328	4.384	4.697	4.369	4.203	4.501
DT3	3.028	2.938	3.087	3.098	3.455	3.326	3.723	3.223
DT4	8.074	7.712	7.942	7.307	7.997	8.414	8.345	7.967
DT5	12.567	11.876	12.361	11.585	12.715	13.402	13.365	12.540
P1	284.057	285.553	286.454	280.585	291.102	284.322	292.503	286.249
P2	144.122	144.980	145.127	146.875	149.576	149.781	156.387	147.880
P3	203.015	194.786	204.681	203.732	213.913	220.648	234.871	210.147
DP1	53.024	51.379	51.886	45.995	47.814	58.693	52.844	51.696
DP2	60.143	60.529	67.438	65.072	73.593	75.084	74.538	67.892
DP3	68.684	66.130	65.556	57.255	57.846	69.223	59.329	63.636
DP4	40.497	40.329	40.405	40.417	40.462	40.162	40.636	40.409
DP5	60.070	59.293	60.565	58.433	59.810	60.095	60.608	59.833
DP6	107.064	100.237	102.750	107.190	107.410	114.074	135.690	109.895
Q1	26.346	25.160	25.404	22.981	23.380	25.404	23.460	24.646
Q2	24.380	23.004	23.761	21.706	22.566	21.544	19.622	22.463
Q3	14.050	13.986	14.036	13.949	14.035	13.978	14.041	14.010
Q4	7.629	7.425	7.572	7.425	7.552	7.677	7.766	7.574
Q5	4.003	3.927	3.735	3.694	3.276	4.031	3.771	3.778
KW1	45.451	45.395	45.317	44.205	44.853	45.142	44.830	45.044
KW2	204.050	203.815	213.498	194.934	214.199	214.922	214.959	208.584
KW3	11.707	11.083	11.519	10.842	11.288	11.077	10.679	11.190
KW4	61.971	61.868	61.879	61.572	61.194	60.980	60.339	61.431
KW5	6.866	6.858	6.858	6.842	6.828	6.805	6.818	6.840

Table H-17; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 16 Aug 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	16 Aug	17 Aug	18 Aug	19 Aug	20 Aug	21 Aug	22 Aug	
TOTAL HRS	24	23	24	23	24	24	24	166
HRS(T1-T4)	24	23	24	23	24	24	24	166
T1	11.720	11.814	11.054	10.509	10.050	9.964	10.113	10.741
T3	6.457	6.399	6.247	6.365	5.875	5.706	5.488	6.073
T4	10.719	10.745	9.992	9.564	9.038	9.086	9.264	9.768
T5	7.858	7.807	7.516	7.414	7.025	6.979	6.698	7.325
T6	4.010	3.542	3.442	3.338	2.940	2.907	2.635	3.257
T7	49.717	48.213	47.716	48.008	48.592	46.682	45.444	47.763
T8	58.240	56.692	55.958	56.404	56.833	54.927	53.882	56.129
T10	44.734	43.190	42.840	43.273	43.610	41.742	40.217	42.796
T11	5.635	5.539	5.385	5.288	4.964	4.825	4.583	5.171
DT1	3.863	4.007	3.538	3.096	3.025	2.985	3.416	3.417
DT2	4.262	4.346	3.745	3.199	3.163	3.380	3.775	3.695
DT3	3.847	4.265	4.074	4.075	4.085	4.072	4.062	4.067
DT4	8.523	8.479	8.243	8.396	8.241	8.245	8.438	8.365
DT5	13.506	13.502	13.119	13.131	13.224	13.185	13.665	13.333
P1	293.402	299.331	298.611	287.317	298.654	298.734	297.353	296.235
P2	158.166	157.314	160.112	160.718	162.698	164.048	164.932	161.167
P3	238.987	252.243	245.896	232.257	240.985	247.123	241.527	242.723
DP1	50.624	42.761	47.099	48.616	52.715	55.772	61.581	51.377
DP2	82.533	84.944	103.078	105.094	115.474	93.929	66.969	93.123
DP3	55.126	43.729	46.505	47.447	49.333	49.650	53.012	49.302
DP4	40.294	40.422	40.584	38.843	40.739	41.016	41.136	40.443
DP5	60.347	61.093	61.043	57.770	61.438	61.213	61.017	60.574
DP6	130.160	146.244	120.504	97.131	92.097	125.178	148.873	122.898
Q1	22.419	19.837	20.317	19.968	20.698	20.773	21.380	20.781
Q2	18.963	17.378	18.106	17.826	18.854	17.439	18.496	18.158
Q3	13.998	13.981	13.994	13.390	14.054	14.045	14.061	13.935
Q4	7.684	7.630	7.476	7.319	7.336	7.379	7.430	7.465
Q5	3.903	3.880	3.895	4.413	4.109	4.133	4.008	4.048
KW1	44.567	44.128	44.144	46.540	44.430	44.487	44.396	44.662
KW2	212.685	211.993	211.422	199.475	210.061	202.067	204.166	207.430
KW3	10.542	10.232	10.416	10.010	10.484	10.243	10.468	10.345
KW4	60.170	60.479	59.959	59.639	59.678	59.593	59.522	59.860
KW5	6.809	6.821	6.812	6.509	6.918	6.844	6.857	6.783

Table H-18;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 23 Aug 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	23 Aug	24 Aug	25 Aug	26 Aug	27 Aug	28 Aug	29 Aug	
TOTAL HRS	24	24	24	23	24	23	24	166
HRS(T1-T4)	24	24	24	23	24	23	24	166
T1	10.342	10.475	10.254	10.190	10.549	11.212	11.260	10.611
T3	5.212	5.017	4.907	4.891	4.894	5.009	4.944	4.982
T4	9.247	9.307	9.089	9.106	9.483	10.110	10.061	9.485
T5	6.309	6.186	6.122	6.099	6.222	6.450	6.379	6.252
T6	2.396	2.376	2.362	2.420	2.552	2.620	2.471	2.456
T7	43.982	42.707	40.554	38.199	37.954	39.783	42.307	40.805
T8	52.169	50.611	47.981	45.182	44.809	47.032	50.272	48.320
T10	38.967	37.833	35.843	33.716	33.197	34.692	37.010	35.914
T11	4.300	4.094	4.014	4.064	4.064	4.188	4.144	4.124
DT1	4.032	4.289	4.133	4.090	4.328	4.761	4.881	4.358
DT2	4.035	4.290	4.182	4.215	4.590	5.101	5.116	4.502
DT3	3.914	3.810	3.759	3.680	3.669	3.830	3.909	3.796
DT4	8.187	7.905	7.427	6.983	6.855	7.249	7.965	7.515
DT5	13.201	12.778	12.138	11.467	11.612	12.340	13.262	12.406
P1	296.489	296.524	296.286	297.093	307.993	316.563	314.141	303.545
P2	166.869	167.722	162.648	148.758	149.853	149.024	150.171	156.526
P3	231.305	229.870	233.145	235.612	241.523	245.778	242.263	237.027
DP1	62.867	64.950	66.823	69.385	61.917	56.277	60.340	63.228
DP2	70.371	70.867	64.810	64.268	60.595	59.340	64.823	65.049
DP3	53.088	52.624	52.374	51.993	51.660	52.202	57.042	53.008
DP4	41.163	41.371	41.472	41.773	41.714	41.742	41.560	41.539
DP5	61.593	61.948	61.458	61.480	57.488	57.723	60.704	60.351
DP6	137.180	136.615	147.559	153.856	160.260	163.858	152.365	150.138
Q1	21.218	21.054	20.903	20.759	20.477	20.532	20.944	20.843
Q2	20.011	19.968	20.567	19.432	18.655	18.819	19.648	19.591
Q3	14.043	14.027	13.993	13.978	13.941	14.009	14.078	14.010
Q4	7.590	7.549	7.498	7.387	7.075	7.277	7.607	7.427
Q5	4.029	4.026	3.788	4.045	3.915	3.632	3.231	3.809
KW1	44.441	44.354	44.258	44.216	45.079	46.120	46.494	44.993
KW2	195.360	188.414	166.025	143.713	143.259	157.700	187.457	169.065
KW3	10.903	10.784	11.163	10.636	10.508	10.510	10.667	10.726
KW4	59.315	59.280	53.102	41.313	41.180	41.316	41.262	48.192
KW5	6.868	6.883	6.872	6.860	6.926	6.847	6.865	6.860

Table H-19;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 30 Aug 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	30 Aug	31 Aug	1 Sep	2 Sep	3 Sep	4 Sep	5 Sep	
TOTAL HRS	21	24	24	24	24	24	24	165
HRS(T1-T4)	21	24	24	24	24	24	24	165
T1	11.097	11.164	11.115	11.424	12.228	12.786	13.379	11.899
T3	4.918	4.918	4.777	4.815	4.951	5.069	5.100	4.936
T4	9.890	9.957	9.896	10.098	10.765	11.285	11.748	10.531
T5	6.336	6.355	6.222	6.289	6.538	6.806	6.996	6.509
T6	2.613	2.577	2.583	2.575	2.761	2.842	2.947	2.701
T7	40.163	39.970	38.860	38.784	39.930	44.059	45.222	41.013
T8	47.623	47.435	45.993	45.666	46.997	52.189	53.645	48.523
T10	35.186	35.058	33.964	33.872	34.876	38.465	39.576	35.869
T11	4.121	4.125	4.002	4.059	4.153	4.242	4.275	4.140
DT1	4.761	4.809	4.893	5.134	5.691	5.981	6.383	5.390
DT2	4.971	5.039	5.119	5.283	5.814	6.217	6.648	5.595
DT3	3.723	3.778	3.638	3.714	3.777	3.964	4.049	3.808
DT4	7.461	7.465	7.133	6.882	7.067	8.130	8.423	7.510
DT5	12.437	12.377	12.029	11.794	12.121	13.724	14.070	12.654
P1	312.150	313.961	312.930	308.638	298.787	301.458	308.752	308.023
P2	149.854	149.819	152.562	154.088	153.438	155.120	155.320	152.941
P3	243.441	242.419	243.912	242.162	242.103	239.619	239.324	241.825
DP1	61.066	62.851	63.803	64.082	64.098	71.362	73.550	65.917
DP2	65.398	63.707	60.675	60.919	58.690	58.365	60.064	61.038
DP3	55.470	56.868	56.258	55.310	54.700	61.636	63.428	57.707
DP4	41.606	41.696	41.543	41.882	41.635	41.340	41.041	41.533
DP5	60.110	61.288	60.248	61.114	60.802	61.241	61.577	60.926
DP6	151.788	154.421	158.935	158.759	161.127	156.112	154.494	156.605
Q1	20.777	20.795	20.536	20.232	19.870	20.884	20.849	20.559
Q2	19.675	19.673	19.584	19.543	19.430	20.056	20.072	19.720
Q3	14.021	14.021	13.942	14.010	14.007	14.066	14.016	14.012
Q4	7.446	7.552	7.346	7.455	7.527	7.568	7.667	7.510
Q5	3.532	3.560	3.160	2.751	3.307	3.393	3.431	3.301
KW1	46.398	46.253	46.329	45.763	44.188	45.241	46.340	45.777
KW2	168.340	165.183	153.730	143.970	153.054	196.255	204.509	169.309
KW3	10.560	10.625	10.605	10.618	10.571	10.704	10.679	10.639
KW4	41.280	41.300	41.099	40.905	40.935	40.853	40.829	41.024
KW5	6.863	6.874	6.865	6.872	6.858	6.863	6.852	6.864

Table H-20;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 6 Sep 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	6 Sep	7 Sep	8 Sep	9 Sep	10 Sep	11 Sep	12 Sep	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	13.808	14.387	14.789	14.997	15.078	14.961	14.900	14.703
T3	5.266	5.467	5.407	5.151	5.052	5.116	5.172	5.233
T4	12.117	12.613	13.566	13.718	13.204	13.039	13.037	13.042
T5	7.225	7.529	6.886	6.770	7.059	7.109	7.250	7.118
T6	3.017	3.280	3.002	2.932	2.908	2.908	3.024	3.010
T7	45.270	45.776	45.825	45.139	45.304	45.010	45.340	45.381
T8	53.745	54.258	54.293	53.567	53.617	53.273	53.646	53.771
T10	39.568	40.023	39.760	39.304	39.782	39.551	39.744	39.676
T11	4.417	4.627	4.562	4.298	4.181	4.264	4.305	4.379
DT1	6.583	6.858	7.903	8.227	8.019	7.852	7.650	7.584
DT2	6.851	7.146	8.158	8.567	8.151	7.923	7.865	7.809
DT3	4.209	4.249	3.885	3.838	4.151	4.201	4.226	4.108
DT4	8.475	8.482	8.467	8.428	8.313	8.263	8.306	8.390
DT5	14.177	14.235	14.533	14.263	13.836	13.722	13.902	14.095
P1	310.560	310.467	313.391	312.933	308.292	307.358	307.023	310.003
P2	156.282	156.870	157.854	158.891	158.420	161.231	167.125	159.525
P3	244.511	246.408	228.413	237.230	237.782	236.761	238.121	238.475
DP1	70.453	72.265	49.199	51.025	61.688	63.508	65.552	61.956
DP2	57.674	57.944	37.895	40.826	58.665	59.433	57.502	52.848
DP3	57.091	57.488	75.100	77.568	55.311	54.895	53.997	61.636
DP4	40.817	40.839	40.869	41.314	42.395	42.486	42.405	41.589
DP5	60.995	60.929	62.944	62.830	61.521	61.639	61.461	61.760
DP6	162.985	164.940	181.314	178.079	154.488	153.173	157.523	164.643
Q1	19.938	19.719	13.056	14.086	20.438	20.132	20.031	18.200
Q2	19.219	19.029	21.487	21.943	20.172	20.171	19.680	20.243
Q3	14.022	14.023	14.027	14.079	14.246	14.199	14.185	14.111
Q4	7.563	7.567	7.575	7.477	7.566	7.578	7.733	7.583
Q5	3.374	3.395	3.053	3.736	4.018	3.990	3.623	3.598
KW1	46.259	46.148	45.788	45.493	45.433	45.388	45.210	45.674
KW2	202.813	206.076	205.033	203.061	204.467	203.279	204.293	204.146
KW3	10.502	10.493	11.000	11.933	10.671	10.692	10.600	10.942
KW4	40.774	40.648	40.595	40.450	40.483	40.366	39.911	40.460
KW5	6.859	6.858	6.852	6.872	6.879	6.804	6.910	6.962

Table H-21; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 13 Sep 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	13 Sep	14 Sep	15 Sep	16 Sep	17 Sep	18 Sep	19 Sep	
TOTAL HRS	24	23	20	12	24	22	22	147
HRS(T1-T4)	24	23	20	12	24	22	22	147
T1	14.807	15.031	15.113	15.144	15.163	15.260	15.253	15.104
T3	5.241	5.270	5.370	4.994	4.921	5.265	6.503	5.383
T4	13.067	13.167	13.122	14.247	13.020	13.502	14.148	13.405
T5	7.420	7.547	7.667	6.308	7.519	7.312	8.413	7.531
T6	3.198	3.292	3.319	2.790	3.238	3.340	4.289	3.387
T7	44.870	45.391	45.597	44.577	45.465	45.589	46.116	45.418
T8	53.191	53.791	53.934	52.913	53.797	53.931	54.619	53.787
T10	39.284	39.739	39.925	38.759	39.776	39.846	40.401	39.731
T11	4.347	4.321	4.423	4.019	4.033	4.440	5.660	4.486
DT1	7.388	7.484	7.447	8.836	7.644	7.948	6.840	7.573
DT2	7.826	7.897	7.752	9.253	8.099	8.237	7.544	8.022
DT3	4.222	4.255	4.347	3.518	4.282	3.972	4.124	4.145
DT4	8.322	8.400	8.336	8.336	8.332	8.342	8.502	8.369
DT5	13.907	14.052	14.008	14.155	14.021	14.085	14.218	14.056
P1	306.352	305.672	306.914	307.162	300.457	304.112	305.289	304.931
P2	157.323	145.388	153.307	154.023	131.524	137.899	148.422	146.189
P3	245.167	246.429	245.411	250.292	245.527	247.141	229.524	243.829
DP1	67.659	70.113	72.493	38.711	81.354	64.883	62.792	67.430
DP2	52.853	54.467	57.957	31.187	64.594	52.721	44.840	52.729
DP3	54.928	54.117	52.861	106.563	55.115	78.194	63.736	63.566
DP4	42.497	42.296	42.575	42.476	42.534	42.275	42.235	42.408
DP5	61.382	61.773	61.922	64.123	62.326	62.671	63.178	62.356
DP6	170.380	169.362	165.239	183.960	153.298	166.155	169.012	167.983
Q1	19.863	19.721	19.485	9.803	19.782	15.116	15.748	17.629
Q2	18.987	18.862	18.945	25.519	18.610	21.656	18.240	19.721
Q3	14.160	14.195	14.216	14.209	14.244	14.153	14.128	14.185
Q4	7.393	7.640	7.438	7.442	7.569	7.603	7.209	7.474
Q5	3.948	3.915	3.749	4.200	3.934	3.771	3.957	3.909
KW1	45.107	44.964	52.005	67.603	68.424	68.300	67.145	58.436
KW2	203.356	205.033	204.782	204.821	203.738	207.125	200.986	204.204
KW3	10.455	10.463	10.467	15.044	10.431	12.514	10.081	11.081
KW4	30.673	21.637	27.077	32.618	22.108	26.323	41.617	28.517
KW5	6.927	6.962	6.944	6.927	6.830	6.725	6.726	6.859

TAble H-22;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 20 Sep 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	20 Sep	21 Sep	22 Sep	23 Sep	24 Sep	25 Sep	26 Sep	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	15.683	15.471	15.228	14.799	15.050	15.125	15.040	15.199
T3	6.645	6.529	6.282	5.508	5.465	5.545	5.173	5.878
T4	14.722	13.963	14.181	13.739	13.952	13.907	13.673	14.020
T5	8.692	9.155	7.698	6.880	6.902	6.974	6.678	7.568
T6	4.684	4.663	3.828	3.449	3.178	2.999	2.628	3.633
T7	46.666	46.383	44.804	44.947	45.173	45.915	45.736	45.660
T8	55.349	55.070	53.045	52.861	53.154	54.074	53.853	53.915
T10	40.766	40.550	39.207	39.716	39.836	40.457	40.312	40.121
T11	5.803	5.743	5.466	4.672	4.612	4.693	4.340	5.047
DT1	6.990	6.316	7.530	7.920	8.148	8.151	8.362	7.631
DT2	8.078	7.434	7.899	8.232	8.487	8.361	8.500	8.142
DT3	4.008	4.492	3.871	3.430	3.724	3.975	4.050	3.936
DT4	8.683	8.687	8.241	7.914	7.981	8.159	8.118	8.255
DT5	14.582	14.520	13.839	13.145	13.318	13.617	13.541	13.795
P1	300.450	301.764	300.928	287.888	293.639	294.957	297.116	296.678
P2	148.075	148.261	150.229	154.091	155.220	163.175	168.737	155.398
P3	236.991	259.953	223.831	219.193	230.985	234.820	238.373	234.878
DP1	64.398	75.320	43.679	36.526	41.740	39.439	37.787	48.413
DP2	44.559	56.424	40.482	33.217	41.126	41.794	44.785	43.198
DP3	70.817	52.301	73.597	79.514	68.125	62.600	57.460	66.345
DP4	41.925	41.989	41.951	42.004	42.341	42.200	42.188	42.086
DP5	62.427	62.232	60.942	59.573	62.390	62.342	61.249	61.594
DP6	181.300	184.933	113.276	143.151	163.822	167.557	168.458	160.357
Q1	15.660	18.985	12.283	23.720	21.971	21.066	20.175	19.123
Q2	19.427	15.605	21.409	22.529	20.769	20.213	19.572	19.932
Q3	14.120	14.151	14.075	14.055	14.177	14.187	14.147	14.130
Q4	7.663	7.587	7.201	7.293	7.375	7.576	7.606	7.472
Q5	3.893	3.855	3.729	4.027	3.754	3.889	3.753	3.843
KW1	67.936	67.660	67.540	68.429	68.285	68.040	68.060	67.991
KW2	210.728	209.328	201.901	197.017	197.322	202.370	201.161	202.833
KW3	10.591	9.941	11.006	11.173	10.825	10.704	10.570	10.686
KW4	41.663	41.682	41.584	41.205	34.370	20.250	20.208	34.423
KW5	6.713	6.742	6.728	6.709	6.729	6.737	6.726	6.726

Table H-23;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 27 Sep 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	27 Sep	28 Sep	29 Sep	30 Sep	1 Oct	2 Oct	3 Oct	
TOTAL HRS	23	24	24	24	24	24	24	167
HRS(T1-T4)	23	24	24	24	24	24	24	167
T1	15.506	15.440	15.426	15.331	14.909	14.053	13.553	14.885
T3	5.449	5.606	5.656	5.343	5.156	5.137	5.010	5.336
T4	14.184	13.888	13.645	14.394	13.438	12.431	12.133	13.440
T5	7.252	7.322	7.289	6.601	7.119	6.790	6.863	7.032
T6	3.356	3.217	3.141	2.791	3.293	2.979	2.991	3.108
T7	44.988	46.711	47.181	45.712	46.266	46.161	45.355	46.060
T8	52.682	54.842	55.197	53.767	54.447	54.246	53.522	54.109
T10	39.671	41.299	41.808	40.316	40.905	40.864	40.208	40.731
T11	4.597	4.702	4.734	4.476	4.337	4.345	4.236	4.489
DT1	8.253	8.118	8.137	8.730	7.791	7.263	6.690	7.852
DT2	8.734	8.282	7.999	9.051	8.282	7.294	7.123	8.104
DT3	3.896	4.105	4.149	3.810	3.825	3.812	3.872	3.924
DT4	7.694	8.131	8.017	8.055	8.181	8.085	8.167	8.049
DT5	13.011	13.543	13.389	13.451	13.542	13.382	13.314	13.378
P1	297.434	293.313	292.814	295.954	286.350	285.963	288.472	291.436
P2	173.189	176.390	179.218	183.606	178.482	157.013	164.862	173.252
P3	244.194	240.878	235.960	224.859	235.227	227.399	235.978	234.872
DP1	38.866	40.527	42.346	29.368	53.659	55.275	57.046	45.337
DP2	48.613	59.912	72.110	42.431	57.981	68.990	68.839	59.907
DP3	57.626	57.207	55.735	74.392	71.577	70.650	70.998	65.502
DP4	41.961	41.958	42.015	41.964	41.892	41.773	41.770	41.904
DP5	59.985	61.749	62.075	63.613	62.824	62.455	62.361	62.165
DP6	172.573	156.084	138.905	172.623	151.837	130.690	142.076	151.990
Q1	20.083	19.884	19.605	13.190	21.666	21.564	21.463	19.634
Q2	18.626	19.129	19.707	21.138	20.003	20.989	19.623	19.896
Q3	14.084	14.130	14.131	14.105	14.128	14.105	14.088	14.110
Q4	7.152	7.578	7.287	7.560	7.655	7.434	7.685	7.481
Q5	3.147	3.511	3.375	3.323	2.474	2.461	3.962	3.179
KW1	61.714	67.564	68.366	68.071	68.763	68.371	66.455	67.075
KW2	190.110	203.195	203.023	200.970	203.052	200.541	201.030	200.335
KW3	10.393	10.493	10.620	10.889	10.671	10.880	10.682	10.663
KW4	19.941	19.845	19.665	19.395	15.319	.360	.337	13.513
KW5	6.724	6.732	6.729	6.709	6.713	6.702	6.713	6.717

Table H-24;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 4 Oct 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	4 Oct	5 Oct	6 Oct	7 Oct	8 Oct	9 Oct	10 Oct	
TOTAL HRS	24	24	24	23	24	24	24	167
HRS(T1-T4)	24	24	24	23	24	24	24	167
T1	12.954	13.148	13.349	13.268	13.132	13.087	13.073	13.144
T3	4.744	4.829	4.767	4.653	4.437	4.487	4.569	4.641
T4	11.467	11.645	11.774	11.657	11.438	11.559	11.357	11.556
T5	6.525	6.711	6.757	6.661	6.217	6.492	6.376	6.534
T6	2.727	2.873	2.900	2.804	2.427	2.602	2.443	2.682
T7	45.285	45.764	46.284	46.788	46.339	46.590	45.460	46.069
T8	53.403	53.841	54.246	54.644	54.118	54.312	53.005	53.934
T10	40.187	40.662	41.109	41.424	40.941	41.053	40.105	40.779
T11	3.975	4.049	3.997	3.893	3.691	3.707	3.795	3.872
DT1	6.429	6.437	6.591	6.607	6.914	6.595	6.697	6.610
DT2	6.723	6.816	7.007	7.005	7.001	7.072	6.787	6.915
DT3	3.798	3.838	3.857	3.858	3.791	3.869	3.933	3.852
DT4	8.118	8.077	7.962	7.866	7.790	7.721	7.545	7.866
DT5	13.216	13.179	13.137	13.220	13.177	13.258	12.900	13.155
P1	299.043	288.993	286.163	283.097	281.883	282.396	273.787	283.626
P2	161.546	159.825	158.553	159.508	161.092	166.308	175.548	163.219
P3	235.543	237.886	239.692	240.704	232.796	239.237	238.327	237.723
DP1	58.166	59.461	60.680	61.468	61.377	63.858	69.553	62.084
DP2	79.795	86.576	93.340	96.368	77.843	70.974	70.600	82.129
DP3	71.706	71.952	70.208	69.234	69.815	67.814	64.801	69.362
DP4	41.855	41.788	42.072	42.182	42.282	42.332	42.396	42.129
DP5	62.724	62.126	62.030	61.846	61.573	62.266	61.564	62.019
DP6	129.299	125.712	121.956	119.645	130.574	145.177	144.398	131.033
Q1	21.401	21.323	21.065	20.844	20.807	20.685	19.969	20.871
Q2	20.158	19.878	19.286	19.232	20.156	18.981	19.247	19.565
Q3	14.066	14.102	14.142	14.163	14.165	14.185	14.161	14.140
Q4	7.632	7.565	7.490	7.398	7.563	7.324	7.321	7.471
Q5	3.905	3.896	3.642	4.175	4.144	3.952	3.352	3.865
KW1	66.765	66.664	67.198	68.728	68.728	68.154	66.548	67.533
KW2	199.517	199.542	200.076	201.060	198.130	199.652	192.547	198.632
KW3	10.820	10.758	10.682	10.641	10.746	10.493	10.566	10.672
KW4	.379	.382	.337	.349	.366	.311	.276	.343
KW5	6.715	6.727	6.719	6.729	6.737	6.727	6.724	6.725

Table H-25;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 11 Oct 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	11 Oct	12 Oct	13 Oct	14 Oct	15 Oct	16 Oct	17 Oct	
TOTAL HRS	23	24	24	24	24	23	24	166
HRS(T1-T4)	23	24	24	24	24	23	24	166
T1	12.100	11.344	10.980	10.765	11.094	11.207	10.678	11.161
T3	4.631	4.443	4.363	4.438	4.916	4.954	3.811	4.505
T4	10.611	9.974	9.647	9.489	9.797	9.971	9.213	9.809
T5	6.349	5.912	5.803	5.879	6.307	6.354	5.167	5.963
T6	3.119	3.035	2.909	2.969	3.231	2.717	2.493	2.925
T7	37.166	37.652	37.632	37.499	39.634	42.352	34.167	37.994
T8	42.575	43.461	43.415	43.292	45.620	49.220	38.777	43.740
T10	32.590	33.462	33.370	33.310	35.011	37.216	28.736	33.367
T11	3.829	3.776	3.686	3.705	4.029	4.744	5.515	4.182
DT1	5.751	5.432	5.177	4.886	4.787	4.852	5.511	5.199
DT2	5.979	5.531	5.284	5.051	4.880	5.017	5.402	5.304
DT3	3.230	2.877	2.894	2.910	3.076	3.637	2.674	3.038
DT4	5.409	5.809	5.782	5.792	5.986	6.868	4.611	5.746
DT5	9.985	9.999	10.044	9.981	10.609	12.003	10.042	10.373
P1	216.137	278.748	279.434	280.076	276.137	277.772	264.803	267.835
P2	180.455	176.807	177.945	182.453	188.764	198.942	215.864	188.736
P3	236.364	224.626	226.318	228.476	230.925	245.388	243.063	233.507
DP1	67.959	90.928	91.183	92.466	90.219	84.521	87.066	86.456
DP2	58.565	79.318	79.455	80.180	82.810	68.389	63.960	73.357
DP3	56.823	87.502	87.135	87.211	83.322	69.465	59.148	75.954
DP4	40.700	43.350	43.128	43.229	43.073	42.697	40.945	42.455
DP5	55.455	60.809	60.266	59.549	58.763	58.977	43.762	56.795
DP6	157.973	118.337	119.983	122.130	122.072	153.548	157.720	135.728
Q1	17.948	22.117	22.008	21.966	21.377	19.868	18.585	20.573
Q2	15.924	21.535	21.551	21.103	20.898	19.294	18.747	19.892
Q3	13.383	14.101	14.111	14.119	14.137	14.107	13.625	13.943
Q4	6.820	7.302	7.267	7.217	7.267	7.195	6.030	7.014
Q5	2.531	4.943	4.307	3.983	3.044	3.468	2.079	3.485
KW1	54.243	65.804	65.405	65.113	67.466	66.787	67.292	64.636
KW2	118.859	127.027	127.548	127.109	137.330	172.516	103.179	130.327
KW3	9.842	11.010	10.965	10.906	10.859	10.881	10.474	10.709
KW4	.312	.351	.347	.331	.298	10.707	34.137	6.654
KW5	6.478	6.927	6.925	6.941	6.990	6.960	6.870	6.872

Table H-26;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 18 Oct 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	18 Oct	19 Oct	20 Oct	21 Oct	22 Oct	23 Oct	24 Oct	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	10.787	10.829	10.205	9.897	10.177	10.341	10.506	10.392
T3	3.799	3.770	3.842	3.910	3.874	4.020	3.878	3.870
T4	9.368	9.328	8.726	9.165	9.351	9.505	9.527	9.281
T5	5.310	5.276	5.194	4.735	4.919	5.150	5.013	5.085
T6	2.542	2.510	2.860	2.710	2.975	3.194	2.773	2.795
T7	35.244	35.169	32.774	32.874	35.635	33.565	36.926	34.607
T8	40.125	40.008	36.689	36.459	39.924	37.908	42.223	39.048
T10	30.097	29.996	25.838	24.868	28.116	27.345	31.240	28.214
T11	5.702	5.821	5.420	5.129	5.423	5.555	5.546	5.514
DT1	5.477	5.553	5.011	5.161	5.258	5.191	5.493	5.306
DT2	5.569	5.558	4.883	5.255	5.477	5.485	5.650	5.411
DT3	2.768	2.766	2.334	2.025	1.944	1.955	2.240	2.290
DT4	4.881	4.839	3.915	3.584	4.289	4.342	5.237	4.441
DT5	10.028	10.012	10.851	11.591	11.808	10.563	10.983	10.834
P1	287.428	282.849	263.022	266.878	275.110	274.227	270.892	274.344
P2	216.928	217.128	216.599	217.713	219.565	219.913	219.839	218.240
P3	242.558	243.378	250.117	225.713	221.906	218.257	210.212	230.306
DP1	96.744	97.281	93.360	54.121	29.028	31.089	35.537	62.451
DP2	67.013	68.736	63.741	31.944	23.763	30.043	51.789	48.147
DP3	66.486	64.130	52.905	77.720	103.955	98.470	119.775	83.349
DP4	41.958	41.803	38.639	37.790	37.927	35.593	38.569	38.897
DP5	49.295	48.524	28.567	21.660	29.836	33.432	42.214	36.218
DP6	154.360	152.656	166.792	128.015	155.461	147.526	130.138	147.850
C1	19.447	19.003	17.506	11.314	23.158	23.280	24.491	19.743
C2	19.023	18.967	17.544	19.223	22.165	22.623	23.734	20.468
C3	13.790	13.763	13.107	12.906	13.076	12.562	13.254	13.208
C4	6.504	6.413	4.329	3.544	4.392	4.828	5.650	5.094
C5	3.184	3.110	2.305	2.912	2.960	3.146	3.021	2.948
KW1	68.030	67.630	66.571	66.208	68.347	68.523	68.384	67.570
KW2	108.946	108.387	88.672	71.766	99.373	84.787	110.642	95.939
KW3	10.515	10.489	10.225	10.213	11.093	11.176	11.392	10.729
KW4	34.264	34.333	34.197	33.925	33.191	32.786	32.784	33.640
KW5	6.923	6.885	5.778	6.700	6.698	6.501	6.647	6.733

Table H-27;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 25 Oct 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	25 Oct	26 Oct	27 Oct	28 Oct	29 Oct	30 Oct	31 Oct	
TOTAL HRS	23	24	24	24	24	24	24	167
HRS(T1-T4)	23	24	24	24	24	24	24	167
T1	10.172	9.604	9.932	9.814	7.599	7.513	7.352	8.847
T3	3.519	3.248	3.469	4.826	3.896	3.482	3.193	3.663
T4	9.233	8.796	8.972	8.147	7.085	6.929	6.712.	7.974
T5	4.726	4.520	5.265	5.048	4.683	4.326	4.054	4.660
T6	2.405	1.865	2.746	3.910	3.035	2.727	2.395	2.728
T7	34.401	29.799	29.755	27.558	34.694	34.252	33.752	32.016
T8	39.168	33.733	33.567	29.716	38.756	38.397	37.958	35.880
T10	28.532	23.448	24.259	23.160	27.123	26.534	26.237	25.596
T11	5.082	4.792	4.814	4.790	5.034	4.286	3.502	4.612
DT1	5.446	5.083	4.667	4.766	2.916	3.187	3.298	4.187
DT2	5.714	5.547	5.503	3.322	3.189	3.447	3.519	4.312
DT3	2.321	2.655	2.519	1.138	1.648	1.599	1.659	1.932
DT4	4.767	3.933	3.812	2.158	4.062	4.145	4.206	3.864
DT5	10.636	10.284	9.309	6.557	11.633	11.863	11.722	10.284
P1	263.290	249.219	271.396	211.946	245.844	251.661	245.633	248.338
P2	219.783	219.406	218.996	219.293	220.875	207.230	173.323	211.221
P3	228.785	269.948	247.526	196.951	185.298	193.346	196.890	216.892
DP1	51.398	89.380	105.373	79.772	74.287	82.601	84.423	81.211
DP2	42.331	22.468	21.699	10.549	43.857	61.260	60.783	37.535
DP3	94.402	43.487	43.047	28.733	82.565	83.522	78.783	64.758
DP4	37.501	35.022	36.177	34.818	33.946	33.902	34.007	35.039
DP5	38.513	26.703	30.840	24.219	25.455	24.948	24.222	27.779
DP6	157.434	203.666	186.696	114.963	95.678	99.308	103.781	137.241
Q1	21.872	15.483	14.645	9.724	27.322	28.132	27.289	20.631
Q2	20.948	13.819	12.759	8.170	24.774	25.897	25.500	18.826
Q3	12.941	12.317	12.546	12.159	12.231	12.224	12.244	12.377
Q4	4.936	3.880	4.735	3.415	3.463	3.914	3.649	3.979
Q5	2.179	1.672	2.823	2.435	2.047	2.185	3.010	2.337
KW1	65.743	57.806	61.794	54.748	66.282	70.158	92.700	67.041
KW2	94.029	74.055	70.379	40.643	68.502	70.930	70.452	69.711
KW3	10.819	9.369	8.575	6.038	11.237	11.723	11.662	9.912
KW4	32.885	32.916	32.780	32.611	32.118	27.450	20.030	30.096
KW5	6.561	6.515	6.547	6.460	6.460	6.460	6.470	6.510

Table H-28;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 1 Nov 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	1 Nov	2 Nov	3 Nov	4 Nov	5 Nov	6 Nov	7 Nov	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	8.035	8.181	8.021	7.825	8.315	9.820	9.034	8.461
T3	3.130	2.812	2.880	2.674	2.735	4.497	3.000	3.104
T4	7.321	7.371	7.178	7.008	7.429	8.666	8.054	7.575
T5	4.217	4.019	4.047	3.942	4.144	5.562	4.588	4.360
T6	2.351	1.955	2.141	1.895	2.106	3.977	2.149	2.368
T7	34.587	35.634	35.723	36.232	36.788	36.168	39.652	36.398
T8	39.333	40.822	40.470	41.334	41.881	39.928	45.646	41.345
T10	28.412	30.897	30.355	31.510	32.079	31.662	35.049	31.424
T11	3.336	5.035	4.735	4.546	4.343	4.943	5.261	4.600
DT1	3.818	4.162	3.974	3.883	4.171	4.252	4.445	4.102
DT2	4.191	4.559	4.298	4.334	4.694	4.170	5.053	4.471
DT3	1.867	2.064	1.906	2.047	2.039	1.584	2.439	1.992
DT4	4.746	5.188	4.747	5.102	5.093	3.761	5.994	4.947
DT5	10.921	9.925	10.115	9.823	9.802	8.266	10.597	9.921
P1	248.930	248.433	242.910	252.571	252.738	208.066	253.159	243.830
P2	184.846	194.081	194.946	202.217	217.570	219.679	223.715	205.293
P3	202.449	203.685	196.202	206.357	208.119	160.743	211.487	198.435
DP1	87.282	88.078	86.724	93.112	94.085	71.627	98.358	88.467
DP2	58.914	61.265	61.960	68.040	72.418	57.271	80.827	65.814
DP3	78.958	77.788	74.041	76.447	75.884	57.336	73.985	73.491
DP4	36.443	39.731	37.707	40.299	39.881	35.350	40.161	38.510
DP5	36.423	53.782	44.297	58.485	57.968	37.829	59.556	49.763
DP6	111.619	110.214	104.615	107.265	105.106	77.414	100.496	102.390
Q1	27.345	27.120	25.951	27.121	27.033	20.263	26.796	25.947
Q2	24.846	24.689	23.501	24.333	24.095	17.877	23.498	23.263
Q3	12.727	13.394	13.007	13.535	13.473	12.348	13.600	13.155
Q4	4.953	6.579	5.843	6.990	7.025	4.839	7.167	6.199
Q5	3.780	3.623	2.970	2.650	2.593	2.894	3.133	3.092
KW1	91.031	91.378	87.595	92.896	93.215	82.804	93.176	90.299
KW2	89.480	110.497	96.068	110.548	109.603	77.366	128.695	103.179
KW3	11.539	11.517	11.024	11.416	11.360	9.530	11.302	10.955
KW4	19.531	18.834	18.731	18.208	16.952	16.100	15.605	17.710
KW5	6.570	6.727	6.607	6.731	6.707	6.248	6.639	6.604

Table H-29; CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 8 Nov 1995

DAY	1	2	3	4	5	6	7	WEEK
DATE	8 Nov	9 Nov	10 Nov	11 Nov	12 Nov	13 Nov	14 Nov	
TOTAL HRS	21	24	24	24	24	24	24	165
HRS(T1-T4)	21	24	24	24	24	24	24	165
T1	8.960	8.661	9.072	8.623	9.240	12.314	8.921	9.407
T3	2.490	2.337	2.339	2.254	3.024	11.241	10.937	4.991
T4	7.928	7.723	8.011	7.615	8.201	12.352	9.980	8.846
T5	4.217	4.000	4.076	3.933	4.424	10.377	8.771	5.712
T6	1.953	2.161	2.201	2.029	3.044	11.124	9.090	4.561
T7	39.000	37.695	38.139	38.089	36.257	15.428	11.144	30.673
T8	44.779	42.913	43.350	43.288	41.240	19.567	12.555	35.214
T10	34.119	31.731	32.395	32.382	32.634	19.404	12.512	27.769
T11	4.482	2.638	2.652	2.824	3.596	9.408	10.387	5.153
DT1	4.744	4.661	4.996	4.690	4.816	1.937	.150	3.695
DT2	5.439	5.386	5.672	5.361	5.177	1.112	-.958	3.856
DT3	2.264	1.839	1.875	1.904	1.380	-.747	-.320	1.151
DT4	5.779	5.218	5.211	5.199	4.982	4.139	1.411	4.541
DT5	10.660	11.181	10.954	10.906	8.605	.163	.043	7.444
P1	254.988	254.289	255.061	255.886	220.016	109.405	256.371	230.421
P2	229.298	229.036	228.993	237.017	216.670	58.140	58.136	178.709
P3	213.571	215.213	216.918	218.633	175.743	31.183	32.969	156.718
DP1	106.634	129.132	131.691	133.325	103.024	21.854	67.991	98.956
DP2	80.232	66.310	70.964	74.601	62.512	0.000	0.000	50.122
DP3	72.063	67.218	63.921	63.853	51.100	13.207	39.931	52.696
DP4	39.511	37.905	37.977	37.850	30.205	.310	.389	26.067
DP5	54.031	38.928	40.247	40.521	33.814	.996	1.088	29.509
DP6	98.158	96.260	94.483	92.833	73.973	.321	.248	64.583
C1	26.347	25.235	24.615	24.506	19.545	5.180	15.632	20.039
C2	23.160	22.975	22.753	22.398	17.699	.040	.025	15.440
C3	13.497	13.167	13.164	13.123	15.419	23.753	23.802	16.616
C4	5.587	.769	1.108	1.131	1.244	0.000	0.000	1.329
C5	3.050	3.060	3.034	3.103	2.719	2.953	2.810	2.960
KW1	93.229	92.994	92.797	92.710	88.175	75.085	83.588	88.280
KW2	124.427	112.177	112.750	112.289	89.248	1.194	.917	78.174
KW3	11.260	11.252	11.205	11.164	8.845	.134	.135	7.649
KW4	15.361	15.704	15.590	15.197	11.445	.134	.090	10.415
KW5	6.624	6.555	6.569	6.562	5.227	.104	.088	4.495

TAble H-30;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 15 Nov 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	15 Nov	16 Nov	17 Nov	18 Nov	19 Nov	20 Nov	21 Nov	
TOTAL HRS	24	22	23	24	24	24	24	165
HRS(T1-T4)	24	22	23	24	24	24	24	165
T1	9.775	9.527	9.618	9.284	7.898	10.181	10.677	9.566
T3	9.432	8.711	8.922	9.112	9.036	10.151	9.992.	9.347
T4	9.135	9.173	9.262	9.453	8.983	10.059	10.203	9.471
T5	8.883	8.663	8.881	8.816	7.885	9.667	10.080	8.987
T6	9.679	9.377	9.435	9.290	8.142	10.129	10.577	9.521
T7	9.445	8.844	9.038	9.304	9.703	10.410	10.129	9.565
T8	10.207	9.368	9.341	9.518	9.889	10.527	10.497	9.925
T10	10.027	9.137	9.042	9.271	9.676	10.373	10.104	9.671
T11	9.608	8.905	8.876	9.092	9.533	9.987	9.423	9.354
DT1	.886	.864	.737	.469	.013	.514	.596	.578
DT2	-.297	.462	.340	.341	-.054	-.092	.211	.125
DT3	-.790	-.714	-.553	-.475	-.257	-.462	-.496	-.533
DT4	.762	.524	.304	.214	.186	.177	.368	.360
DT5	.180	.230	.300	.247	.213	.214	.393	.254
P1	274.569	257.558	244.189	241.082	228.515	29.208	29.602	185.176
P2	57.971	58.133	58.049	57.789	57.546	57.439	65.121	59.023
P3	34.879	35.376	35.643	35.084	13.220	17.100	18.715	26.994
DP1	0.000	0.000	0.000	23.180	93.570	0.000	0.000	16.982
DP2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP3	.283	.192	.259	14.197	58.628	.182	.216	10.753
DP4	.464	.477	.469	.436	.402	.389	.414	.435
DP5	1.202	1.218	1.245	1.191	1.088	1.093	1.166	1.171
DP6	0.000	0.000	0.000	0.000	.065	0.000	0.000	.010
O1	.032	.028	.027	5.414	22.450	.004	.008	4.067
O2	.125	.175	.140	.120	0.000	0.000	0.000	.079
O3	23.852	23.852	23.849	23.833	23.808	23.785	23.780	23.822
O4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
O5	3.283	3.144	2.564	3.623	3.051	2.830	2.402	2.986
KW1	67.917	68.301	59.291	74.663	89.278	69.449	68.910	71.221
KW2	1.405	1.635	.898	.847	.996	.956	.899	1.085
KW3	.134	.149	.154	.133	.123	.129	.137	.137
KW4	.056	.082	.095	.069	.059	.066	.700	.165
KW5	.077	.079	.083	.078	.078	.088	.085	.081

Table H-31;

```
EDIT/PLOT     ;FINAL PLOTS   ;CALCULATIONS  :             ;
              :              :              :             : EXIT
                   CLEARWATER MONITORING SYSTEM
              AVERAGE DATA FOR WEEK STARTING 22 Nov 1985

         DAY       1        2        3        4        5        6        7     WEEK
        DATE  22 Nov   23 Nov   24 Nov   25 Nov   26 Nov   27 Nov   28 Nov
   TOTAL HRS      23       24       24       24       23       24       24      166
 HRS(T1-T4)       23       24       24       24       23       24       24      166
          T1  10.531   10.716    9.690   10.363    8.250    4.982    4.771    8.461
          T3   9.808   10.562   10.083    9.342    8.188    8.870    9.140    9.433
          T4  10.031   10.932   10.084    9.776    9.024    8.354    8.538    9.534
          T5   9.308    9.763    8.760    9.395    7.595    5.002    8.484    8.328
          T6   9.712   10.252    9.475   10.091    8.027    5.275    8.352    8.739
          T7  10.178   10.933   10.265    9.758    8.649    9.120   18.067   11.015
          T8  10.407   11.313   10.832   10.242    9.112    9.433   21.488   11.857
         T10  10.082   10.847   10.390    9.845    8.725    9.046   24.347   11.927
         T11   7.420    8.034    8.549    8.683    4.442    4.993    4.694    6.697
         DT1   1.223     .953     .930     .968     .655    -.020   -3.713     .133
         DT2    .223     .370     .001     .434     .836    -.516    -.602     .101
         DT3   -.404    -.489    -.716    -.696    -.431    -.273     .133    -.411
         DT4    .229     .380     .567     .483     .463     .313    3.421     .842
         DT5    .326     .466     .442     .397     .387     .387   -2.858    -.070
          P1  70.092  123.345   80.849   73.565  221.566  274.909  161.688  143.691
          P2 158.937  174.692  190.367  153.621   90.557  130.376  170.378  153.041
          P3  19.008   19.013   18.876   20.968   37.064   43.657   52.327   30.156
         DP1   2.895    1.247     .385    0.000   26.987  101.112    7.888   20.135
         DP2   0.000    0.000    0.000    0.000    0.000    0.000     .152     .022
         DP3   2.065     .456     .231     .018   19.624   74.335    6.313   14.767
         DP4    .404     .380     .424     .418     .471     .419     .343     .408
         DP5   1.080    1.077    1.197    1.138    1.231    1.117    1.101    1.134
         DP6   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
          O1    .915     .055     .019     .008    7.092   27.132    2.241    5.368
          O2   0.000    0.000    0.000     .008     .133     .109     .207     .065
          O3  23.768   23.792   23.820   23.825   23.866   23.837   23.792   23.814
          O4   0.000    0.000    0.000    0.000    0.000    0.000    3.459     .500
          O5   2.960    2.996    1.988     .032     .938    3.566    3.058    2.223
         KW1  74.747   74.754   69.094   63.140  100.755   63.282   68.157   73.246
         KW2   1.048    1.111    1.660    1.053     .988     .943    1.015    1.118
         KW3    .139     .148     .150     .133     .126     .127     .128     .136
         KW4  34.415   38.483   32.800   12.015    5.691   21.782   39.192   26.416

         KW5    .087     .095     .086     .083     .066     .072     .086     .082
```

Table H-31;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 29 Nov 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	29 Nov	30 Nov	1 Dec	2 Dec	3 Dec	4 Dec	5 Dec	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	4.478	4.478	4.996	5.392	3.328	2.877	2.776	4.047
T3	10.280	10.323	10.427	9.814	8.628	9.827	10.217	9.931
T4	10.770	10.900	10.858	10.248	9.184	10.355	10.757	10.439
T5	10.613	10.675	10.752	9.929	8.890	10.113	10.515	10.213
T6	9.334	9.333	9.498	9.177	7.919	8.469	8.586	8.902
T7	11.157	10.971	11.041	9.989	8.780	10.289	10.747	10.425
T8	12.133	11.423	11.230	10.952	9.624	10.764	11.166	11.042
T10	13.199	11.335	11.025	10.190	9.131	10.233	10.713	10.832
T11	4.407	4.383	4.656	5.472	5.177	4.266	3.669	4.576
DT1	-6.135	-6.198	-5.756	-4.537	-5.562	-7.236	-7.740	-6.166
DT2	.489	.576	.431	.434	.556	.528	.539	.508
DT3	1.280	1.342	1.254	.753	.971	1.644	1.930	1.311
DT4	.976	.451	.188	.963	.844	.475	.420	.617
DT5	-1.066	.087	.205	.762	.493	.531	.453	.209
P1	151.003	150.951	150.980	172.547	250.998	280.689	278.475	205.092
P2	167.293	152.927	139.763	152.572	141.993	137.262	140.102	147.416
P3	47.222	47.426	48.207	47.428	46.393	47.063	47.262	47.286
DP1	0.000	0.000	0.000	0.000	.359	0.000	.061	.060
DP2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP3	.661	1.136	.484	.478	.316	.138	.276	.498
DP4	.363	.370	.379	.418	.449	.380	.371	.390
DP5	1.080	1.097	1.021	1.096	1.210	1.026	1.119	1.093
DP6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q1	.008	.018	.017	.030	.019	.010	.007	.016
Q2	.077	.128	.182	.210	.134	.172	.120	.146
Q3	23.794	23.798	23.795	23.845	23.847	23.806	23.800	23.812
Q4	3.600	3.544	3.932	4.188	3.668	3.639	3.707	3.754
Q5	3.149	3.199	3.034	2.699	2.048	4.462	4.708	3.328
KW1	68.173	68.022	68.611	64.595	42.067	63.497	63.328	62.613
KW2	.986	1.046	1.309	1.046	.986	1.009	1.270	1.093
KW3	.128	.129	.143	.122	.143	.135	.130	.133
KW4	40.420	41.715	42.810	58.935	61.793	63.953	63.660	53.327
KW5	.083	.086	.090	.072	.075	.087	.089	.083

Table H-32;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 6 Dec 1995

DAY	1	2	3	4	5	6	7	WEEK
DATE	6 Dec	7 Dec	8 Dec	9 Dec	10 Dec	11 Dec	12 Dec	
TOTAL HRS	23	23	24	24	24	23	21	162
HRS(T1-T4)	23	23	24	24	24	23	21	162
T1	2.640	2.751	3.192	3.098	2.930	3.398	3.328	3.045
T3	10.185	9.580	9.856	10.349	9.880	9.211	4.196	9.115
T4	10.652	10.088	10.381	10.778	9.831	9.352	7.051	9.778
T5	10.480	9.680	10.015	10.522	9.693	9.035	3.319	9.054
T6	8.404	8.001	8.738	10.996	10.722	9.592	2.386	8.512
T7	10.717	9.838	10.242	10.741	10.126	10.321	35.706	13.621
T8	11.058	10.505	10.729	11.198	10.928	10.816	38.502	14.455
T10	10.695	10.014	10.298	10.714	9.913	9.995	29.166	12.721
T11	3.421	3.210	3.426	3.604	3.514	3.742	3.476	3.485
DT1	-7.841	-6.928	-6.823	-7.424	-6.763	-5.637	.009	-6.008
DT2	.467	.507	.525	.429	-.049	.141	2.855	.663
DT3	2.076	1.679	1.277	-.474	-1.029	-.557	.933	.541
DT4	.341	.667	.487	.457	.802	.495	2.795	.834
DT5	.363	.491	.432	.484	1.015	.821	9.336	1.734
P1	278.293	279.387	277.506	277.817	280.382	279.896	279.463	278.950
P2	135.713	134.543	136.171	132.733	129.331	124.637	121.717	130.841
P3	47.240	47.093	47.433	46.954	47.108	57.314	301.484	81.574
DP1	.027	0.000	.043	0.000	0.000	0.000	0.000	.010
DP2	0.000	0.000	0.000	0.000	2.497	11.049	0.000	1.939
DP3	.371	.279	.175	0.000	0.000	2.860	65.554	9.022
DP4	.379	.428	.396	.387	.425	1.817	35.883	5.203
DP5	1.128	1.147	1.104	1.156	1.160	1.565	23.633	4.115
DP6	0.000	0.000	0.000	0.000	0.000	8.756	12.464	2.859
Q1	.005	.013	.005	0.000	0.000	1.082	25.341	3.442
Q2	.138	.128	.131	.149	.126	.803	1.580	.417
Q3	23.807	23.828	23.807	23.809	23.846	23.830	23.616	23.795
Q4	3.801	3.756	3.816	3.698	3.610	3.663	3.760	3.729
Q5	4.556	4.510	4.746	3.960	2.992	3.143	2.848	3.836
KW1	63.716	63.857	63.259	63.850	62.812	62.598	63.843	63.412
KW2	1.193	1.313	1.248	1.072	1.050	3.215	55.779	8.542
KW3	.135	.147	.147	.140	.135	.544	6.709	1.050
KW4	64.143	64.363	64.119	64.390	43.125	43.405	43.641	55.491
KW5	.086	.081	.088	.086	.072	.345	6.406	.940

Table H-33;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 13 Dec 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	13 Dec	14 Dec	15 Dec	16 Dec	17 Dec	18 Dec	19 Dec	
TOTAL HRS	24	24	12	0	0	0	9	69
HRS(T1-T4)	24	24	12	0	0	0	9	69
T1	3.769	3.105	2.307	0.000	0.000	0.000	-.003	2.792
T3	3.998	5.506	11.721	0.000	0.000	0.000	7.830	6.365
T4	7.035	8.016	12.582	0.000	0.000	0.000	8.302	8.506
T5	3.759	4.140	11.278	0.000	0.000	0.000	8.122	5.768
T6	2.777	3.664	12.271	0.000	0.000	0.000	8.966	5.544
T7	36.903	36.066	36.300	0.000	0.000	0.000	8.644	32.821
T8	39.710	37.740	35.902	0.000	0.000	0.000	8.869	34.340
T10	31.168	32.684	36.082	0.000	0.000	0.000	8.094	29.541
T11	3.296	3.266	3.006	0.000	0.000	0.000	1.413	2.990
DT1	.010	-1.035	-8.971	0.000	0.000	0.000	-8.125	-2.976
DT2	3.037	2.511	.861	0.000	0.000	0.000	.472	2.141
DT3	.982	.476	-.992	0.000	0.000	0.000	-.844	.224
DT4	2.807	1.674	-.398	0.000	0.000	0.000	.224	1.519
DT5	8.542	5.055	-.180	0.000	0.000	0.000	.775	4.799
P1	281.515	280.609	260.555	0.000	0.000	0.000	282.724	277.712
P2	118.352	115.229	116.552	0.000	0.000	0.000	117.658	116.862
P3	302.016	213.883	39.468	0.000	0.000	0.000	40.636	191.607
DP1	.121	.064	0.000	0.000	0.000	0.000	0.000	.064
DP2	0.000	0.000	0.000	0.000	0.000	0.000	.721	.094
DP3	63.890	34.380	0.000	0.000	0.000	0.000	.147	34.200
DP4	36.548	36.581	35.324	0.000	0.000	0.000	.448	31.638
DP5	28.283	28.697	21.789	0.000	0.000	0.000	1.216	23.767
DP6	13.259	10.380	2.311	0.000	0.000	0.000	0.000	8.624
Q1	24.805	13.877	0.000	0.000	0.000	0.000	.044	13.460
Q2	1.791	1.471	.106	0.000	0.000	0.000	.084	1.164
Q3	23.603	23.618	23.703	0.000	0.000	0.000	23.860	23.659
Q4	4.513	4.621	3.980	0.000	0.000	0.000	2.128	4.147
Q5	2.604	2.590	2.523	0.000	0.000	0.000	3.027	2.640
KW1	57.537	61.921	62.933	0.000	0.000	0.000	62.057	60.590
KW2	56.978	38.685	1.573	0.000	0.000	0.000	1.320	33.720
KW3	6.723	4.524	.157	0.000	0.000	0.000	.137	3.957
KW4	43.882	44.052	43.972	0.000	0.000	0.000	43.833	43.950
KW5	6.441	6.430	6.350	0.000	0.000	0.000	.070	5.590

Table H-35;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 20 Dec 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	25 Dec	26 Dec	
TOTAL HRS	22	24	24	24	24	24	24	166
HRS(T1-T4)	22	24	24	24	24	24	24	166
T1	.420	.236	.560	1.577	2.233	2.715	1.939	1.394
T3	8.483	8.783	8.455	8.303	9.126	9.451	8.557	8.740
T4	8.841	9.161	8.813	8.608	9.329	9.699	9.075	9.078
T5	8.868	9.209	8.818	8.612	9.465	9.628	8.878	9.071
T6	9.621	9.984	9.590	9.412	10.250	10.571	9.761	9.887
T7	8.892	9.163	8.8[illegible]1	8.761	9.669	9.934	9.267	9.216
T8	7.970	8.419	7.974	8.174	8.997	9.793	9.516	8.700
T10	8.867	9.274	8.967	8.747	9.560	9.894	9.183	9.217
T11	1.318	1.459	1.525	2.028	2.645	3.230	3.086	2.195
DT1	-8.448	-8.973	-8.258	-7.035	-7.232	-6.913	-6.939	-7.676
DT2	.358	.378	.359	.304	.204	.248	.518	.338
DT3	-.753	-.775	-.773	-.800	-.786	-.943	-.884	-.817
DT4	-.922	-.743	-.827	-.587	-.672	-.142	.249	-.516
DT5	-.898	-.855	-.994	-.573	-.563	-.101	.333	-.517
P1	282.535	295.276	295.832	297.791	296.837	297.160	295.947	294.627
P2	120.557	122.644	108.082	111.418	111.461	111.578	109.947	113.587
P3	40.913	41.218	41.289	41.240	41.305	41.275	40.975	41.177
DP1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP2	.706	.705	.708	.716	.698	.697	.717	.707
DP3	.010	0.000	.004	0.000	0.000	0.000	0.000	.002
DP4	.430	.430	.450	.445	.400	.415	.445	.431
DP5	1.098	1.183	1.196	1.158	1.126	4.587	3.665	2.013
DP6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q1	.020	.028	.025	.044	.033	.010	.021	.026
Q2	.086	.076	.083	.080	.117	.072	.081	.085
Q3	23.850	23.847	23.857	23.860	23.831	23.835	23.856	23.848
Q4	2.437	2.585	2.500	2.548	2.666	2.814	2.550	2.588
Q5	3.232	2.883	2.994	2.844	2.927	2.893	2.818	2.938
KW1	63.689	63.167	63.128	62.977	62.701	62.615	62.713	62.990
KW2	2.156	1.542	1.577	1.514	1.511	1.639	1.568	1.638
KW3	.135	.135	.139	.134	.138	.139	.138	.137
KW4	43.625	37.871	22.122	22.024	22.084	22.056	22.074	27.213
KW5	.070	.072	.072	.071	.079	.079	.075	.074

Table H-36;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 27 Dec 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	27 Dec	28 Dec	29 Dec	30 Dec	31 Dec	1 Jan	2 Jan	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	1.858	1.871	2.004	1.514	2.111	2.156	1.873	1.912
T3	8.407	7.997	8.063	8.325	8.307	8.920	8.478	8.357
T4	8.796	8.344	8.382	8.665	8.623	9.151	8.814	8.682
T5	8.691	8.297	8.410	8.632	8.583	9.232	8.671	8.645
T6	9.544	9.164	9.255	9.517	9.448	10.049	9.603	9.511
T7	9.136	8.632	8.758	9.010	8.976	9.568	9.040	9.017
T8	8.953	8.384	8.877	8.709	8.593	9.316	8.527	8.766
T10	8.846	8.387	8.372	8.698	8.685	9.247	8.895	8.733
T11	2.995	2.904	2.895	2.954	3.237	3.465	3.282	3.105
DT1	-6.834	-6.427	-6.407	-7.118	-6.472	-7.076	-6.798	-6.733
DT2	.389	.347	.319	.340	.317	.231	.336	.325
DT3	-.852	-.867	-.845	-.885	-.865	-.817	-.932	-.866
DT4	-.183	-.248	.119	-.302	-.383	-.252	-.512	-.252
DT5	.107	-.002	.505	.010	-.092	.068	-.367	.033
P1	297.532	292.265	283.584	286.902	304.926	303.578	295.123	294.844
P2	116.561	121.361	123.612	129.818	129.937	130.143	127.965	125.628
P3	41.060	41.145	40.937	40.580	40.921	40.814	40.939	40.914
DP1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP2	.720	.730	.721	.727	.713	.705	.733	.721
DP3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP4	.449	.465	.454	.452	.442	.427	.451	.448
DP5	1.236	1.231	1.227	1.248	1.166	1.218	1.224	1.221
DP6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
O1	.012	.019	.012	.020	.019	.014	.014	.016
O2	.078	.085	.085	.085	.077	.078	.081	.081
O3	23.865	23.875	23.865	23.865	23.858	23.844	23.865	23.863
O4	2.669	2.540	2.742	2.387	2.624	2.429	2.194	2.512
O5	2.828	2.642	2.634	2.931	2.926	2.913	2.830	2.815
KW1	64.839	64.817	64.100	62.537	64.407	64.019	64.851	64.224
KW2	1.460	1.474	1.380	1.462	1.510	1.352	1.641	1.469
KW3	.130	.131	.137	.135	.130	.144	.136	.135
KW4	21.921	21.799	21.733	21.483	21.466	21.463	21.612	21.640
KW5	.070	.068	.071	.073	.070	.080	.073	.072

Table H-37;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 27 Dec 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	27 Dec	28 Dec	29 Dec	30 Dec	31 Dec	1 Jan	2 Jan	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	1.858	1.871	2.004	1.514	2.111	2.156	1.873	1.912
T3	8.407	7.997	8.063	8.325	8.307	8.920	8.478	8.357
T4	8.796	8.344	8.382	8.665	8.623	9.151	8.814	8.682
T5	8.691	8.297	8.410	8.632	8.583	9.232	8.671	8.645
T6	9.544	9.164	9.255	9.517	9.448	10.049	9.603	9.511
T7	9.136	8.632	8.758	9.010	8.976	9.568	9.040	9.017
T8	8.953	8.384	8.877	8.709	8.593	9.316	8.527	8.766
T10	8.846	8.387	8.372	8.698	8.685	9.247	8.895	8.733
T11	2.995	2.904	2.895	2.954	3.237	3.465	3.282	3.105
DT1	-6.834	-6.427	-6.407	-7.118	-6.472	-7.076	-6.798	-6.733
DT2	.389	.347	.319	.340	.317	.231	.336	.325
DT3	-.852	-.867	-.845	-.885	-.865	-.817	-.932	-.866
DT4	-.183	-.248	.119	-.302	-.383	-.252	-.512	-.252
DT5	.107	-.002	.505	.010	-.092	.068	-.367	.033
P1	297.532	292.265	283.584	286.902	304.926	303.578	295.123	294.844
P2	116.561	121.361	123.612	129.818	129.937	130.143	127.965	125.628
P3	41.060	41.145	40.937	40.580	40.921	40.814	40.939	40.914
DP1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP2	.720	.730	.721	.727	.713	.705	.733	.721
DP3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP4	.449	.465	.454	.452	.442	.427	.451	.448
DP5	1.236	1.231	1.227	1.248	1.166	1.218	1.224	1.221
DP6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q1	.012	.019	.012	.020	.019	.014	.014	.016
Q2	.078	.085	.085	.085	.077	.078	.081	.081
Q3	23.865	23.875	23.865	23.865	23.858	23.844	23.865	23.863
Q4	2.669	2.540	2.742	2.387	2.624	2.429	2.194	2.512
Q5	2.828	2.642	2.634	2.931	2.926	2.913	2.830	2.815
KW1	64.839	64.817	64.100	62.537	64.407	64.019	64.851	64.224
KW2	1.460	1.474	1.380	1.462	1.510	1.352	1.641	1.469
KW3	.130	.131	.137	.135	.130	.144	.136	.135
KW4	21.921	21.799	21.733	21.483	21.466	21.463	21.612	21.640
KW5	.070	.068	.071	.073	.070	.080	.073	.072

Table-38;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 3 Jan 1986

DAY	1	2	3	4	5	6	7	WEEK
DATE	3 Jan	4 Jan	5 Jan	6 Jan	7 Jan	8 Jan	9 Jan	
TOTAL HRS	24	24	19	22	24	22	24	159
HRS(T1-T4)	24	24	19	22	24	22	24	159
T1	2.041	1.189	1.152	.528	-.519	-1.169	-.064	.449
T3	8.697	7.932	7.484	5.733	5.254	3.699	1.745	5.766
T4	8.945	8.216	7.744	5.982	5.547	4.898	3.403	6.372
T5	8.924	8.442	7.933	5.974	5.483	3.578	1.921	6.009
T6	9.760	9.108	8.520	6.655	6.272	3.918	1.290	6.470
T7	9.212	8.534	7.652	5.546	5.338	21.389	38.876	13.994
T8	9.282	8.304	6.760	6.590	6.097	23.257	41.474	14.773
T10	9.127	8.461	8.009	6.065	5.603	18.999	28.975	12.299
T11	3.332	2.892	2.672	2.465	2.145	.932	1.253	2.242
DT1	-6.883	-7.253	-6.781	-5.446	-6.002	-4.747	-1.985	-5.560
DT2	.248	.285	.261	.249	.293	1.199	1.658	.606
DT3	-.835	-.666	-.586	-.681	-.789	-.339	.631	-.462
DT4	.070	-.230	-.893	1.044	.759	1.868	2.599	.779
DT5	.156	-.157	-1.250	.525	.493	4.258	12.500	2.474
P1	297.757	297.610	302.797	302.059	305.004	282.533	300.287	298.302
P2	125.710	123.538	123.467	121.852	120.097	114.986	112.345	120.232
P3	40.343	39.656	40.458	39.945	40.645	106.319	149.723	65.883
DP1	0.000	0.000	0.000	0.000	0.000	.662	4.005	.696
DP2	.704	.748	.759	.805	.795	.723	.598	.732
DP3	0.000	0.000	0.000	0.000	.004	26.608	94.415	17.934
DP4	.441	.470	.506	.584	.570	14.869	34.133	7.574
DP5	1.192	1.197	1.211	1.300	1.286	6.939	10.589	3.438
DP6	0.000	0.000	0.000	0.000	0.000	15.513	16.991	4.711
Q1	.009	.026	.021	.038	.041	.020	.005	.023
Q2	.106	.095	.103	.176	.178	10.204	30.663	6.134
Q3	23.867	23.877	23.905	23.970	23.961	10.507	23.730	22.032
Q4	2.795	2.274	2.837	2.203	1.970	2.222	1.725	2.274
Q5	2.816	2.814	2.796	2.605	2.817	2.229	2.763	2.695
KW1	60.950	64.203	63.899	59.097	60.657	64.033	60.754	61.890
KW2	1.576	1.396	1.390	1.251	1.238	20.749	56.565	12.384
KW3	.130	.141	.139	.121	.125	5.246	12.605	2.722
KW4	21.611	21.754	21.733	21.726	21.910	22.023	22.161	21.848
KW5	.073	.072	.064	.042	.044	2.752	6.545	1.411

Table H-39;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 10 Jan 1986

DAY	8	9	10	11	12	13	14	WEEK
DATE	10 Jan	11 Jan	12 Jan	13 Jan	14 Jan	15 Jan	16 Jan	
TOTAL HRS	24	24	24	23	24	24	23	166
HRS(T1-T4)	24	24	24	23	24	24	23	166
T1	.540	.621	1.394	1.827	.801	-1.075	-1.385	.391
T3	1.902	1.854	2.141	2.824	2.462	1.138	5.487	2.525
T4	4.119	4.216	4.342	5.172	5.039	3.543	6.757	4.726
T5	2.067	2.017	2.304	2.980	2.611	1.302	3.510	2.388
T6	1.455	1.394	1.684	2.318	1.828	.801	5.900	2.174
T7	40.057	40.097	41.770	43.031	49.834	45.438	28.323	41.288
T8	42.626	42.581	44.142	45.392	52.514	47.412	33.103	44.024
T10	32.573	34.962	37.596	40.604	47.453	43.158	31.348	38.269
T11	1.347	1.317	1.635	2.341	1.976	.665	.007	1.329
DT1	-1.527	-1.396	-.910	-1.153	-1.810	-2.376	-4.895	-1.997
DT2	2.217	2.362	2.201	2.348	2.577	2.405	1.270	2.202
DT3	.612	.623	.620	.662	.783	.501	-2.390	.215
DT4	2.569	2.484	2.372	2.362	2.680	1.975	4.780	2.736
DT5	10.053	7.618	6.545	4.788	5.062	4.254	1.755	5.755
P1	248.955	245.844	246.771	249.319	250.927	267.929	288.797	256.788
P2	112.057	111.948	111.799	111.671	111.622	109.809	105.541	110.660
P3	149.756	149.934	149.857	150.026	151.266	158.372	48.530	137.272
DP1	3.955	4.132	3.957	3.146	.171	.254	.055	2.246
DP2	.505	.513	.514	.448	.431	.545	.650	.515
DP3	93.293	93.662	93.208	92.054	93.074	98.481	28.410	84.891
DP4	35.321	37.152	38.503	41.517	41.770	41.821	8.489	35.058
DP5	15.408	23.613	32.320	55.151	62.085	60.108	2.989	36.036
DP6	16.959	16.857	17.022	17.285	17.006	17.303	5.623	15.484
Q1	.003	0.000	0.000	.002	0.000	.001	.010	.002
Q2	30.564	30.638	30.724	30.816	30.526	31.269	8.657	27.694
Q3	23.637	23.613	23.622	20.175	14.103	13.952	3.154	17.535
Q4	2.857	4.521	5.345	7.361	7.975	7.675	1.427	5.320
Q5	3.465	3.260	3.254	3.154	1.927	1.796	1.786	2.666
KW1	67.095	67.265	67.057	65.040	64.897	63.169	61.867	65.220
KW2	57.210	56.964	57.765	61.500	73.313	58.248	16.074	54.628
KW3	12.567	12.577	12.582	12.570	12.633	13.329	4.143	11.523
KW4	22.246	22.295	22.316	22.314	22.340	22.302	22.335	22.307
KW5	6.638	6.738	6.771	6.881	6.733	6.687	1.699	6.042

Table H-40;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 17 Jan 1986

DAY	1	2	3	4	5	6	7	WEEK
DATE	17 Jan	18 Jan	19 Jan	20 Jan	21 Jan	22 Jan	23 Jan	
TOTAL HRS	23	23	24	24	24	24	24	166
HRS(T1-T4)	23	23	24	24	24	24	24	166
T1	-.805	.153	.925	1.866	2.151	2.488	2.353	1.324
T3	.814	1.582	2.319	2.861	3.161	3.427	3.484	2.537
T4	3.342	4.376	5.248	5.683	6.020	6.229	6.357	5.340
T5	.977	1.735	2.462	3.006	3.304	3.569	3.624	2.684
T6	.573	1.350	2.090	2.458	2.760	3.027	3.070	2.205
T7	51.274	54.155	56.779	53.300	54.840	54.453	55.734	54.382
T8	53.185	55.999	58.557	55.166	56.682	56.324	57.550	56.228
T10	43.989	49.264	53.498	51.082	52.658	52.233	53.582	50.952
T11	.358	1.123	1.886	2.432	2.786	3.046	3.136	2.126
DT1	-1.782	-1.581	-1.538	-1.140	-1.153	-1.081	-1.271	-1.360
DT2	2.529	2.794	2.929	2.822	2.859	2.802	2.873	2.803
DT3	.404	.384	.372	.548	.544	.542	.554	.479
DT4	1.911	1.844	1.778	1.866	1.841	1.871	1.815	1.846
DT5	9.196	6.736	5.059	4.084	4.024	4.091	3.968	5.276
P1	297.076	296.917	294.867	268.934	266.340	260.875	259.692	277.583
P2	106.689	106.831	106.796	106.038	106.331	105.864	106.166	106.383
P3	151.539	152.503	157.238	180.418	181.589	183.334	184.465	170.374
DP1	0.000	0.000	0.000	.086	.174	.050	.130	.064
DP2	.557	.477	.419	.438	.418	.425	.417	.449
DP3	85.961	86.140	84.404	76.795	77.403	78.156	79.597	81.150
DP4	32.737	34.342	36.691	39.818	39.617	39.652	39.366	37.507
DP5	11.043	18.120	31.872	49.793	49.490	50.034	49.376	37.375
DP6	15.358	15.915	16.811	19.830	20.242	22.586	22.256	19.040
Q1	.001	.010	0.000	0.000	.006	0.000	0.000	.002
Q2	30.665	30.528	30.121	27.329	27.285	26.912	26.719	28.483
Q3	12.303	12.741	13.271	13.778	13.755	13.745	13.774	13.348
Q4	1.886	3.567	5.457	7.120	7.104	7.123	7.115	5.660
Q5	2.651	2.700	2.676	2.014	1.998	1.984	2.077	2.295
KW1	61.690	61.723	61.850	63.035	63.163	63.467	63.449	62.637
KW2	58.441	59.085	61.090	60.395	60.907	61.816	60.559	60.347
KW3	12.637	12.622	12.532	12.118	12.107	12.050	12.006	12.292
KW4	22.402	22.445	22.488	22.417	22.403	22.456	22.448	22.437
KW5	6.303	6.405	6.538	6.643	6.670	6.670	6.684	6.561

Table H-41;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 24 Jan 1986

DAY	8	9	10	11	12	13	14	WEEK
DATE	24 Jan	25 Jan	26 Jan	27 Jan	28 Jan	29 Jan	30 Jan	
TOTAL HRS	24	24	24	24	24	23	24	167
HRS(T1-T4)	24	24	24	24	24	23	24	167
T1	1.039	.732	1.821	2.886	2.878	2.221	1.346	1.844
T3	2.833	2.137	2.598	3.073	2.822	2.535	2.319	2.617
T4	5.748	5.098	5.580	6.116	5.702	5.154	5.211	5.518
T5	2.975	2.279	2.736	2.995	2.871	2.216	1.469	2.508
T6	2.554	1.936	2.370	2.068	1.621	1.663	1.052	1.896
T7	57.968	59.541	61.734	31.683	31.999	25.797	23.275	41.809
T8	59.588	61.014	63.153	34.838	35.416	27.729	24.995	43.915
T10	56.170	57.973	60.244	18.721	16.492	11.256	10.927	33.243
T11	2.412	1.713	2.197	2.665	2.433	2.144	1.888	2.208
DT1	-1.936	-1.547	-.915	-.108	.007	.005	-.123	-.664
DT2	2.915	2.961	2.981	3.044	2.880	2.619	2.892	2.900
DT3	.421	.343	.365	.926	1.251	.553	.417	.611
DT4	1.619	1.473	1.419	3.155	3.417	1.932	1.720	2.106
DT5	3.418	3.041	2.908	16.117	18.924	16.473	14.068	10.672
P1	256.730	255.242	255.553	262.583	277.013	276.077	275.409	265.452
P2	106.293	106.439	106.761	107.356	107.098	107.064	107.421	106.918
P3	165.190	163.253	167.074	211.936	242.633	271.968	263.380	211.847
DP1	0.000	0.000	0.000	.008	0.000	0.000	.004	.002
DP2	.438	.453	.409	.471	.588	.577	.556	.499
DP3	92.735	96.746	100.067	67.658	43.287	43.356	50.579	70.796
DP4	40.219	40.512	40.511	32.159	31.778	31.463	31.641	35.493
DP5	55.819	59.100	61.223	9.310	7.346	4.140	4.431	28.915
DP6	17.353	16.205	17.103	159.426	202.698	202.597	187.769	114.210
Q1	.001	0.000	.002	19.043	22.575	22.595	21.049	12.118
Q2	28.887	29.240	28.513	22.871	18.097	13.497	14.509	22.283
Q3	13.947	14.025	14.067	11.839	11.767	11.535	11.477	12.672
Q4	7.564	7.843	8.016	1.473	.969	.489	.581	3.868
Q5	2.086	2.086	2.087	2.092	2.055	2.033	2.043	2.069
KW1	63.724	63.813	63.840	63.539	62.820	62.704	62.808	63.325
KW2	60.796	60.183	59.509	54.030	59.073	41.295	37.251	53.234
KW3	12.344	12.369	12.263	11.316	10.388	9.261	9.533	11.081
KW4	22.485	22.440	22.514	22.392	22.374	22.315	22.306	22.404
KW5	6.720	6.748	6.733	6.300	6.268	6.227	6.221	6.461

Table H-42;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 31 Jan 1986

DAY	1	2	3	4	5	6	7	WEEK
DATE	31 Jan	1 Feb	2 Feb	3 Feb	4 Feb	5 Feb	6 Feb	
TOTAL HRS	23	23	24	24	24	24	24	166
HRS(T1-T4)	23	23	24	24	24	24	24	166
T1	.921	.661	1.226	.591	.648	.795	.119	.708
T3	2.386	2.808	3.353	6.559	2.691	2.237	2.021	3.157
T4	4.217	4.655	5.143	7.261	4.163	4.048	4.013	4.790
T5	2.543	2.964	3.506	5.903	2.349	2.394	2.176	3.124
T6	1.796	2.204	2.739	6.811	2.141	1.721	1.514	2.712
T7	34.523	36.105	37.858	14.707	35.389	37.741	39.144	33.618
T8	37.469	39.053	40.796	15.439	37.777	40.256	41.584	36.027
T10	24.245	25.802	27.606	11.160	25.178	28.308	29.959	24.603
T11	1.957	2.346	2.873	1.907	1.599	1.745	1.553	1.995
DT1	-1.622	-2.303	-2.279	-5.312	-1.701	-1.599	-2.057	-2.416
DT2	1.831	1.847	1.790	.702	1.472	1.811	1.993	1.633
DT3	.747	.760	.767	-.908	.208	.674	.661	.411
DT4	2.946	2.948	2.938	.733	2.388	2.516	2.441	2.409
DT5	13.224	13.251	13.191	4.279	12.598	11.949	11.626	11.424
P1	289.179	305.823	301.987	261.313	277.681	277.049	282.138	284.874
P2	109.249	109.508	110.118	114.122	114.577	115.008	116.295	112.737
P3	168.603	173.037	174.841	52.090	158.122	184.889	187.875	156.900
DP1	.083	.117	.061	0.000	.036	.060	.165	.074
DP2	.550	.549	.540	.643	.617	.554	.541	.571
DP3	100.828	106.451	107.974	25.965	88.968	107.346	111.443	92.579
DP4	31.766	31.664	31.485	8.267	28.826	32.972	32.786	28.210
DP5	10.337	10.045	10.375	2.629	7.837	10.151	10.096	8.764
DP6	17.916	17.230	16.860	7.455	14.612	15.921	15.667	15.065
Q1	.002	0.000	.002	.005	.003	0.000	0.000	.002
Q2	28.541	28.203	28.065	6.739	23.487	26.331	26.040	23.861
Q3	11.838	11.840	11.826	2.890	10.593	12.108	12.111	10.441
Q4	1.563	1.630	1.609	.344	1.264	1.565	1.513	1.353
Q5	2.400	2.497	2.494	2.478	2.487	2.498	2.493	2.478
KW1	61.865	60.977	61.195	63.480	62.907	62.990	62.465	62.279
KW2	54.833	55.847	57.115	8.858	49.338	56.586	56.644	48.377
KW3	12.326	12.290	12.221	3.114	10.535	11.916	11.882	10.592
KW4	22.340	22.534	22.497	22.227	22.177	22.227	22.210	22.315
KW5	6.284	6.292	6.269	1.628	5.558	6.347	6.348	5.523

Table H-43;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 7 Feb 1986

DAY	8	9	10	11	12	13	14	WEEK
DATE	7 Feb	8 Feb	9 Feb	10 Feb	11 Feb	12 Feb	13 Feb	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	-.176	-.158	-.036	.268	.359	.323	.231	.116
T3	1.919	2.088	2.255	2.466	2.754	2.785	2.815	2.440
T4	3.929	4.036	4.101	4.339	4.860	4.731	4.927	4.418
T5	2.072	2.243	2.411	2.619	2.902	2.936	2.963	2.592
T6	1.397	1.570	1.755	1.948	2.223	2.243	2.317	1.922
T7	38.794	40.438	41.783	43.012	44.249	46.603	46.778	43.094
T8	41.167	42.750	44.037	45.216	46.416	48.752	48.797	45.305
T10	32.129	33.888	35.566	37.633	39.668	42.995	43.401	37.897
T11	1.506	1.683	1.837	2.058	2.345	2.388	2.402	2.031
DT1	-2.248	-2.401	-2.448	-2.351	-2.543	-2.613	-2.732	-2.477
DT2	2.010	1.948	1.846	1.872	2.106	1.947	2.112	1.977
DT3	.676	.673	.656	.670	.679	.693	.646	.671
DT4	2.372	2.312	2.255	2.205	2.167	2.149	2.019	2.211
DT5	9.037	8.862	8.471	7.583	6.749	5.757	5.397	7.408
P1	298.991	298.524	299.470	299.699	300.654	299.921	299.678	299.562
P2	116.516	116.432	116.584	117.518	120.753	124.604	125.906	119.759
P3	190.226	192.559	194.906	196.845	198.894	198.857	199.728	196.002
DP1	.117	.115	.124	.130	.095	.278	.227	.155
DP2	.527	.527	.555	.532	.466	.508	.481	.514
DP3	115.317	118.617	122.598	125.270	128.047	127.986	129.243	123.868
DP4	34.440	34.295	34.531	35.161	35.909	37.479	37.480	35.614
DP5	15.326	15.540	16.210	19.123	23.117	31.880	32.284	21.926
DP6	15.459	15.345	15.096	14.982	15.141	15.072	15.019	15.159
Q1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q2	25.699	25.423	25.135	24.829	24.521	24.458	24.444	24.930
Q3	12.416	12.420	12.472	12.693	12.811	13.167	13.203	12.740
Q4	2.833	2.809	2.995	3.681	4.408	5.451	5.501	3.954
Q5	2.498	2.493	2.514	2.771	2.779	2.775	2.790	2.660
KW1	61.681	61.481	61.409	61.341	61.419	61.411	61.613	61.479
KW2	56.360	57.119	57.780	58.045	59.133	59.400	58.470	58.044
KW3	11.817	11.773	11.763	11.680	11.621	11.619	11.611	11.698
KW4	22.355	22.359	22.353	22.299	22.225	22.114	22.116	22.260
KW5	6.431	6.445	6.460	6.482	6.506	6.573	6.590	6.498

Table H-44;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 14 Feb 1986

DAY	1	2	3	4	5	6	7	WEEK
DATE	14 Feb	15 Feb	16 Feb	17 Feb	18 Feb	19 Feb	20 Feb	
TOTAL HRS	24	22	24	24	24	24	24	166
HRS(T1-T4)	24	22	24	24	24	24	24	166
T1	.416	.338	-.121	-.086	.204	-.100	.299	.133
T3	2.808	2.825	2.547	2.305	2.369	2.364	2.392	2.512
T4	5.022	5.094	4.869	4.772	4.771	4.912	4.992	4.917
T5	3.036	2.976	2.699	2.456	2.514	2.509	2.533	2.671
T6	2.746	2.789	2.526	2.296	2.018	2.030	2.045	2.345
T7	37.108	36.633	37.202	37.279	48.768	50.925	52.564	43.001
T8	38.409	37.833	38.369	38.415	50.474	52.612	54.204	44.409
T10	29.511	27.191	27.957	29.263	46.321	48.957	50.793	37.262
T11	2.424	2.450	2.155	1.885	1.934	1.929	1.972	2.103
DT1	-2.620	-2.638	-2.821	-2.542	-2.310	-2.609	-2.234	-2.538
DT2	2.215	2.269	2.322	2.467	2.402	2.547	2.600	2.405
DT3	.289	.187	.173	.160	.496	.479	.489	.327
DT4	1.301	1.200	1.167	1.136	1.706	1.687	1.639	1.408
DT5	8.898	10.641	10.411	9.151	4.153	3.655	3.411	7.147
P1	299.912	300.522	300.159	297.999	297.723	297.770	296.411	298.620
P2	125.915	125.610	126.308	135.272	139.303	139.310	140.838	133.314
P3	186.597	190.326	190.599	190.773	187.383	187.121	187.730	188.627
DP1	.113	.186	.066	.122	.065	.069	.190	.115
DP2	.533	.536	.552	.530	.478	.460	.447	.505
DP3	119.767	123.312	123.895	123.763	118.975	118.500	119.393	121.060
DP4	30.970	30.582	30.550	31.065	38.820	40.232	40.836	[illegible]
DP5	10.824	3.711	4.381	4.300	40.932	51.021	56.446	24.767
DP6	14.564	15.052	14.808	14.815	15.282	15.317	15.255	15.013
Q1	0.000	0.000	0.000	0.000	0.000	0.000	.001	0.000
Q2	24.276	25.709	25.578	25.526	25.913	25.876	25.874	25.534
Q3	11.458	11.553	11.587	11.697	13.510	13.799	13.973	12.523
Q4	1.832	.570	.660	.757	6.327	7.219	7.642	3.609
Q5	2.780	2.795	2.787	2.786	2.793	2.915	2.924	2.826
KW1	61.573	61.678	61.655	61.834	61.932	62.782	62.873	62.051
KW2	41.867	41.123	40.656	40.548	57.075	58.947	59.306	48.592
KW3	11.311	11.850	11.861	11.834	11.838	11.835	11.826	11.764
KW4	22.102	22.117	22.094	37.892	42.833	42.878	42.810	33.381
KW5	6.093	6.270	6.267	6.290	6.685	6.754	6.802	6.454

Table H-45

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 21 Feb 1986

DAY	8	9	10	11	12	13	14	WEEK
DATE	21 Feb	22 Feb	23 Feb	24 Feb	25 Feb	26 Feb	27 Feb	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	.963	1.227	1.194	1.229	1.073	.652	.734	1.010
T3	2.696	3.119	3.284	3.373	3.380	3.238	3.174	3.180
T4	5.085	4.884	4.898	4.984	5.024	4.363	4.548	4.827
T5	2.843	3.269	3.437	3.526	3.530	3.397	3.324	3.332
T6	2.359	2.337	2.489	2.635	2.458	2.216	2.154	2.378
T7	50.631	34.698	34.984	35.644	39.669	42.564	43.394	40.226
T8	52.209	37.391	37.666	38.221	42.562	45.582	46.417	42.864
T10	48.717	31.124	31.381	32.041	36.185	39.517	40.446	37.059
T11	2.314	2.682	2.825	2.911	2.938	2.800	2.697	2.738
DT1	-1.880	-2.041	-2.242	-2.297	-2.458	-2.746	-2.589	-2.322
DT2	2.389	1.765	1.614	1.611	1.644	1.125	1.374	1.646
DT3	.484	.932	.948	.891	1.072	1.182	1.170	.954
DT4	1.578	2.693	2.681	2.577	2.893	3.018	3.024	2.638
DT5	3.493	6.267	6.285	6.180	6.377	6.065	5.971	5.805
P1	296.743	296.376	296.729	295.216	296.864	297.309	297.519	296.680
P2	143.713	144.947	145.230	149.671	151.884	158.700	163.303	151.064
P3	188.600	199.145	199.952	200.848	201.442	202.098	202.678	199.252
DP1	.066	.180	.044	.142	.102	.075	.145	.108
DP2	.493	.527	.541	.555	.507	.593	.552	.538
DP3	118.504	111.493	113.151	114.913	115.024	116.643	116.592	115.189
DP4	40.223	39.323	39.348	38.980	39.750	41.321	41.454	40.057
DP5	54.438	39.690	38.971	38.477	44.770	54.174	55.722	46.606
DP6	17.642	42.045	41.815	41.541	41.591	41.524	41.636	38.256
Q1	0.000	.012	.005	.006	0.000	.005	.010	.006
Q2	25.764	24.556	24.488	24.280	24.232	23.965	24.000	24.469
Q3	13.716	13.315	13.310	13.257	13.467	13.813	13.866	13.535
Q4	7.154	6.098	6.070	5.992	6.412	7.328	7.485	6.648
Q5	2.922	2.924	2.937	2.918	2.930	2.899	2.883	2.916
KW1	62.972	62.889	62.909	62.930	62.921	62.653	62.538	62.830
KW2	54.880	56.294	56.430	54.402	66.547	73.177	74.223	62.279
KW3	11.780	11.586	11.568	11.528	11.498	11.491	11.480	11.562
KW4	42.621	42.507	42.465	42.132	41.956	41.365	41.158	42.029
KW5	6.732	6.670	6.684	6.673	6.710	6.771	6.790	6.719

Table H-46;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 28 Feb 1986

DAY	1	2	3	4	5	6	7	WEEK
DATE	28 Feb	1 Mar	2 Mar	3 Mar	4 Mar	5 Mar	6 Mar	
TOTAL HRS	24	24	24	24	23	20	24	163
HRS(T1-T4)	24	24	24	24	23	20	24	163
T1	.758	1.090	1.205	1.486	1.622	1.492	1.631	1.320
T3	3.211	3.455	3.612	3.674	2.644	2.154	2.173	3.017
T4	4.676	5.086	5.354	5.890	5.251	4.974	4.589	5.120
T5	3.358	3.597	3.754	3.812	2.784	2.339	2.395	3.170
T6	2.192	2.438	2.656	2.982	2.035	1.841	1.755	2.283
T7	44.011	44.893	47.415	57.320	56.706	54.067	50.112	50.525
T8	47.002	47.889	50.329	59.916	59.077	56.026	52.160	53.094
T10	41.157	42.169	44.434	53.260	52.783	45.459	45.329	46.353
T11	2.723	2.942	3.112	3.266	2.362	1.904	1.868	2.615
DT1	-2.600	-2.507	-2.549	-2.325	-1.162	-.846	-.764	-1.850
DT2	1.465	1.631	1.742	2.215	2.607	2.780	2.415	2.103
DT3	1.167	1.159	1.098	.829	.750	.497	.640	.887
DT4	2.991	2.996	2.914	2.596	2.371	1.959	2.048	2.569
DT5	5.845	5.720	5.894	6.656	6.295	10.567	6.831	6.741
P1	295.772	295.810	296.045	282.644	214.108	206.652	233.472	262.254
P2	174.721	175.065	175.787	180.623	185.719	197.135	206.527	184.783
P3	202.986	203.290	201.150	191.915	191.443	190.305	195.824	196.891
DP1	.136	.095	.124	.020	.066	.028	.083	.080
DP2	.545	.481	.464	.449	.426	.464	.357	.455
DP3	117.660	117.299	118.133	123.623	122.694	121.773	90.258	115.735
DP4	41.549	41.738	40.658	36.402	37.224	30.338	33.290	37.486
DP5	57.756	59.281	54.492	32.899	37.246	8.924	18.727	39.208
DP6	41.409	41.844	36.519	16.134	16.388	16.424	20.714	27.388
Q1	.025	.003	.007	0.000	0.000	0.000	.006	.006
Q2	23.935	23.945	24.293	25.262	25.491	25.462	23.187	24.481
Q3	13.914	13.945	13.810	13.250	13.359	11.895	12.169	13.223
Q4	7.564	7.747	7.367	5.669	5.775	1.502	3.741	5.724
Q5	2.874	2.883	2.890	2.820	2.477	2.519	2.516	2.717
KW1	62.562	62.549	62.607	63.073	65.629	65.939	65.249	63.885
KW2	73.599	74.473	75.541	77.663	74.109	58.193	56.587	70.289
KW3	11.465	11.445	11.503	11.698	11.710	11.726	11.085	11.513
KW4	39.993	39.997	39.935	39.443	38.735	37.211	36.008	38.798
KW5	6.802	6.790	6.770	6.629	6.686	6.387	8.275	6.625

able H-47;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 7 Mar 1986

DAY	8	9	10	11	12	13	14	WEEK
DATE	7 Mar	8 Mar	9 Mar	10 Mar	11 Mar	12 Mar	13 Mar	
TOTAL HRS	23	24	24	15	24	24	24	158
HRS(T1-T4)	23	24	24	15	24	24	24	158
T1	1.299	-.011	.174	.304	1.344	1.412	1.160	.837
T3	4.747	2.007	1.828	2.177	2.116	2.916	2.396	2.609
T4	5.712	4.037	4.171	4.652	4.322	5.305	5.352	4.795
T5	4.304	2.164	1.975	2.289	2.273	3.064	1.675	2.537
T6	4.716	1.573	1.409	2.143	2.088	2.872	1.441	2.315
T7	28.666	48.540	49.756	38.013	42.023	43.660	39.398	41.712
T8	34.984	50.364	51.517	39.054	42.994	44.639	40.407	43.725
T10	34.654	44.082	45.942	32.081	34.004	37.456	17.767	35.318
T11	1.927	1.594	1.357	1.234	1.733	2.516	1.967	1.790
DT1	-3.005	-2.175	-1.802	-1.985	-.928	-1.652	-.515	-1.700
DT2	.965	2.029	2.343	2.474	2.206	2.389	2.956	2.187
DT3	-.413	.590	.566	.146	.185	.192	.234	.222
DT4	6.318	1.824	1.761	1.041	.971	.980	1.009	2.013
DT5	.330	6.283	5.576	6.973	8.990	7.183	22.639	8.407
P1	285.323	290.646	289.502	286.712	304.017	303.263	278.463	291.421
P2	206.815	210.886	185.491	192.977	191.335	181.110	189.745	194.032
P3	70.279	204.457	206.018	194.100	203.369	204.805	226.229	187.373
DP1	.089	.095	.063	.120	.177	.266	.029	.120
DP2	.705	.587	.512	.562	.586	.542	.587	.583
DP3	29.966	109.838	111.133	104.072	111.923	113.742	67.611	92.356
DP4	10.999	35.748	36.390	32.013	31.555	32.282	29.750	29.814
DP5	7.463	20.361	23.987	7.391	4.016	6.475	4.464	10.796
DP6	9.349	21.605	21.620	19.973	16.833	16.633	154.435	38.365
Q1	.016	0.000	0.000	.001	0.000	0.000	15.596	2.372
Q2	7.351	24.777	24.545	22.858	24.860	24.666	19.301	21.187
Q3	3.862	12.857	13.025	11.904	11.893	12.083	11.441	11.004
Q4	1.217	3.980	4.456	1.251	.654	.944	.725	1.930
Q5	.013	.013	.015	.006	.005	.002	.003	.008
KW1	62.844	62.379	62.564	62.788	61.459	61.258	63.015	62.300
KW2	19.066	58.069	57.216	38.824	41.466	41.788	38.828	42.517
KW3	3.629	11.636	11.592	10.815	11.624	11.599	10.242	10.166
KW4	36.609	37.411	21.461	20.095	20.235	34.423	37.902	30.239
KW5	2.046	6.587	6.623	6.363	6.343	6.412	6.247	5.795

Table H-48;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 14 Mar 1985

DAY	1	2	3	4	5	6	7	WEEK
DATE	14 Mar	15 Mar	16 Mar	17 Mar	18 Mar	19 Mar	20 Mar	
TOTAL HRS	24	22	23	24	23	23	24	163
HRS(T1-T4)	24	22	23	24	23	23	24	163
T1	1.134	1.609	1.652	2.086	2.362	3.003	3.426	2.186
T3	1.557	1.821	1.940	2.258	2.551	2.975	3.601	2.391
T4	3.789	3.901	4.024	4.341	4.483	4.592	4.802	4.279
T5	1.713	1.978	2.097	2.412	2.706	3.132	3.757	2.547
T6	1.323	1.579	1.692	1.992	2.297	2.359	2.599	1.980
T7	35.091	35.758	35.979	36.727	37.239	38.447	40.524	37.124
T8	36.324	36.980	37.212	37.963	38.479	40.306	43.146	38.650
T10	8.344	8.688	8.867	9.333	9.714	12.184	15.659	10.422
T11	1.201	1.468	1.571	1.919	2.206	2.624	3.336	2.052
DT1	-.580	-.369	-.445	-.326	-.344	-.129	-.331	-.361
DT2	2.232	2.080	2.083	2.083	1.931	1.617	1.200	1.888
DT3	.390	.398	.405	.421	.409	.773	1.158	.568
DT4	1.233	1.222	1.233	1.236	1.240	1.860	2.622	1.526
DT5	27.980	28.292	28.344	28.630	28.765	28.122	27.488	28.227
P1	221.539	228.363	225.554	226.519	231.752	238.731	255.708	232.658
P2	190.926	190.467	190.976	197.107	148.722	161.555	172.948	179.034
P3	243.180	243.995	245.460	246.010	246.365	244.610	243.747	244.763
DP1	.172	.235	.203	.185	.220	.112	.159	.183
DP2	.596	.598	.591	.570	.579	.605	.599	.591
DP3	60.503	63.905	68.011	71.631	73.644	74.794	73.445	69.436
DP4	28.875	28.830	28.788	28.799	28.784	29.148	30.010	29.038
DP5	1.584	1.406	1.416	1.980	1.453	2.228	3.138	1.896
DP6	153.311	151.181	148.829	146.096	144.571	142.556	141.467	146.834
Q1	0.000	.001	0.000	0.000	0.000	.001	0.000	0.000
Q2	19.177	18.999	18.688	18.485	18.215	18.324	18.368	18.607
Q3	11.164	11.172	11.158	11.191	11.227	11.285	11.582	11.256
Q4	.318	.332	.291	.379	.317	.332	.391	.338
Q5	.003	.001	.001	0.000	0.000	0.000	.001	.001
KW1	55.356	65.270	65.310	65.098	65.052	66.223	66.419	65.536
KW2	39.709	40.140	40.160	40.469	40.732	49.181	57.997	44.116
KW3	10.498	10.469	10.422	10.337	10.288	10.313	10.311	10.376
KW4	37.861	37.932	37.924	37.096	21.982	20.657	19.310	30.367
KW5	6.205	6.197	6.206	6.365	6.379	6.313	6.277	6.278

Table H-49;

CLEARWATER MONITORING SYSTEM
AVERAGE DATA FOR WEEK STARTING 21 Mar 1985

DAY	8	9	10	11	12	13	14	WEEK
DATE	21 Mar	22 Mar	23 Mar	24 Mar	25 Mar	26 Mar	27 Mar	
TOTAL HRS	24	24	24	24	24	24	24	168
HRS(T1-T4)	24	24	24	24	24	24	24	168
T1	2.399	2.551	2.504	3.026	2.697	3.461	3.654	2.899
T3	2.816	2.645	2.658	3.064	2.854	3.447	3.123	2.944
T4	4.167	3.956	4.099	4.369	4.160	4.510	6.215	4.497
T5	2.973	2.802	2.812	3.217	3.011	3.606	3.641	3.152
T6	1.855	1.699	1.715	2.102	1.900	2.439	2.711	2.060
T7	39.523	39.472	39.633	40.434	40.428	39.581	41.017	40.013
T8	42.082	42.013	42.179	42.993	42.940	42.173	44.477	42.694
T10	15.193	15.346	15.579	16.261	16.289	17.041	19.591	16.472
T11	2.513	2.423	2.391	2.859	2.547	3.147	2.715	2.656
DT1	-.574	-.252	-.308	-.192	-.314	-.145	.013	-.253
DT2	1.351	1.311	1.441	1.305	1.307	1.062	3.092	1.553
DT3	1.118	1.104	1.097	1.116	1.111	1.167	.931	1.092
DT4	2.559	2.541	2.546	2.558	2.512	2.592	3.460	2.681
DT5	26.889	26.667	26.600	26.732	26.651	25.131	24.886	26.222
P1	243.965	234.063	232.289	248.254	190.926	231.398	242.254	231.878
P2	191.545	204.430	203.859	211.113	196.233	190.602	166.448	194.890
P3	243.656	243.493	242.951	242.929	243.415	243.351	239.879	242.811
DP1	.181	.225	.225	.133	.193	.258	.349	.224
DP2	.602	.615	.579	.586	.592	.617	.542	.590
DP3	74.128	74.277	72.205	72.706	71.322	68.862	120.238	79.105
DP4	30.432	30.428	30.330	30.175	30.483	30.744	31.650	30.606
DP5	2.869	3.373	2.991	3.368	2.979	3.639	4.930	3.450
DP6	141.088	141.103	141.713	141.295	143.542	145.925	203.636	151.186
Q1	0.000	.001	.004	0.000	0.000	0.000	28.745	4.107
Q2	18.276	18.258	18.347	18.200	18.191	18.255	18.774	18.329
Q3	11.608	11.604	11.598	11.577	11.653	11.690	11.929	11.665
Q4	.431	.409	.470	.420	.490	.462	.669	.479
Q5	1.357	1.791	1.898	1.652	.500	0.000	0.000	1.028
KW1	67.051	67.293	67.303	66.433	67.907	66.949	66.618	67.079
KW2	56.547	57.196	57.012	57.198	56.995	57.556	69.515	58.860
KW3	10.342	10.335	10.337	10.315	10.293	10.295	10.547	10.352
KW4	19.072	18.226	18.274	17.717	18.704	19.087	20.365	18.778
KW5	6.449	6.506	6.503	6.482	6.503	6.307	6.365	6.445

Table H-50;

```
                    CLEARWATER MONITORING SYSTEM
             CALCULATIONS FOR WEEK STARTING 27 Apr 1985

 DAY      1      2      3      4      5      6      7     AVE    TOTAL
DATE  27 Apr 28 Apr 29 Apr 30 Apr  1 May  2 May  3 May
 HT1   11.7    2.8    3.1     .2    7.9   -0.0     .1    12.5 6.101E+2
 HT2   -4.5    0.0   -2.0    0.0    0.0    0.0    0.0     -.5-1.550E+2
 HT3    8.5    -.7    5.0    -.1   -3.3    -.1   -0.0    -5.3 2.257E+2
 HT4    5.8    0.0    2.4    0.0    0.0    0.0    0.0      .6 1.994E+2
 HT5    1.0   -0.0     .6    -.1   -0.0    0.0    0.0    -0.0 3.553E+1
 EC1   0.00   0.00   0.00   0.00   0.00   0.00   0.00    0.00     0.00
 EC2   5.80   1.40   5.35   1.26   1.02   1.38   1.25    2.49    16.21
 EC3    .79    .11    .77    .10    .09    .11    .10     .29     1.96
 EC4    .23    .14    .13    .14    .14    .17    .13     .15      .95
 EC5    .45    .09    .40    .09    .10    .10    .09     .19     1.23
 TEC   7.26   1.75   6.65   1.58   1.35   1.76   1.57    3.13    20.34
HPEC  .0417 1.8261  .0913 1.9625 2.7665 6.977911.7108   .0813
 PHU 82.00%105.44% 74.32%660.36%129.83%-18.89%-96.78%100.16%
 CCP  1.241   .028   .567   .025   .019   .007   .004    .323
LMTD 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000  .1770  0.0000
 U     0.00   0.00   0.00   0.00   0.00   0.00   0.00    0.00
```

Table H-51;

```
                    CLEARWATER MONITORING SYSTEM
             CALCULATIONS FOR WEEK STARTING  4 May 1985

 DAY      8      9     10     11     12     13     14     AVE    TOTAL  2WK-TOT
DATE   4 May  5 May  6 May  7 May  8 May  9 May 10 May
 HT1     .2     .1    -.2    -.2    -.1    3.9  136.3     1.0 2.543E+3 3.153E+3
 HT2    0.0    0.0    0.0    0.0    0.0   -1.9  143.0      .4 2.526E+3 2.373E+3
 HT3    0.0    0.0    0.0     .1     .1   20.1  258.4     7.9 5.319E+3 5.545E+3
 HT4    0.0    0.0    0.0    0.0    0.0   25.0  477.7    11.4 9.200E+3 9.399E+3
 HT5    0.0    0.0    0.0    0.0    0.0   21.0  485.3    10.4 9.241E+3 9.278E+3
 EC1   0.00   0.00   0.00   0.00   0.00   0.00   0.00    0.00     0.00     0.00
 EC2   1.21   1.36   1.14   1.17    .82  59.69 196.99   37.46   263.64   279.84
 EC3    .09    .10    .10    .08    .07    .62   8.70    1.39     9.95    11.81
 EC4    .10    .10    .10    .06    .04   1.23  21.20    3.26    22.95    23.90
 EC5    .08    .09    .09    .08    .07   2.08   6.16    1.23     8.73     9.95
 TEC   1.48   1.65   1.42   1.40    .99  63.62 233.04   43.37   305.17   325.51
HPEC 6.777516.144814.339620.114435.3699  .0994  .0229   .0287
 PHU 46.53%  PHU 46.63%-99.99%  PHU 46.63%-99.99%-99.99%-99.99%-99.99% 15.99% -
 CCP   .008   .003   .004   .003   .001   .521  2.261    .365
LMTD 0.0000  .1356 0.0000 0.0000 0.0000 0.0000  .7357  0.0000
 U     0.00   0.00   0.00   0.00   0.00   0.00    .52    0.00
```

Table H-52;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 11 May 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	11 May	12 May	13 May	14 May	15 May	16 May	17 May		
HT1	292.3	233.0	228.3	178.8	255.6	285.5	209.5	246.9	3.491E+4
HT2	329.9	264.3	260.2	202.3	299.6	333.5	242.3	283.4	4.003E+4
HT3	167.0	116.7	109.5	98.9	162.7	143.0	140.3	136.8	1.893E+4
HT4	292.3	182.0	170.6	148.7	277.3	244.6	241.8	221.6	3.123E+4
HT5	219.7	40.6	38.2	40.6	243.5	174.9	199.6	141.4	1.811E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	168.24	92.76	81.02	82.47	152.62	143.77	141.75	123.23	720.88
EC3	12.91	12.90	11.88	14.36	14.93	14.89	14.81	13.81	81.87
EC4	27.63	27.55	25.13	26.57	28.71	29.35	48.97	30.56	164.93
EC5	7.89	7.68	7.02	7.41	7.92	7.81	7.81	7.65	45.73
TEC	216.67	140.90	125.05	130.81	204.17	195.82	213.35	175.25	1013.42
HPEC	.0240	.0212	.0216	.0231	.0229	.0245	.0244	.0231	
PHU	24.83%	77.66%	77.63%	72.59%	12.19%	28.49%	17.45%	36.20%	
COP	2.160	2.439	2.399	2.242	2.259	2.115	2.120	2.209	
LMTD	.7387	.6345	.6020	.4752	.6111	.6756	.5635	.6153	
U	1.11	1.03	1.07	1.06	1.17	1.19	1.04	1.13	

Table H-53;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 18 May 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	18 May	19 May	20 May	21 May	22 May	23 May	24 May			
HT1	229.8	217.7	318.1	360.2	276.9	327.9	350.0	298.0	5.497E+4	8.987E+4
HT2	267.2	252.4	378.4	425.3	325.4	390.1	415.4	351.3	6.472E+4	1.048E+5
HT3	168.7	150.8	222.7	252.9	228.4	229.2	242.2	214.1	3.925E+4	5.817E+4
HT4	227.8	256.6	390.7	461.2	412.7	414.7	445.9	378.9	6.987E+4	1.011E+5
HT5	287.2	241.0	420.1	485.7	435.9	451.8	477.7	407.9	7.198E+4	9.008E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	160.31	146.14	232.03	265.11	245.92	248.43	263.15	223.01	1702.86	2423.74
EC3	14.83	14.80	14.74	14.70	14.66	14.68	14.63	14.72	117.84	199.71
EC4	54.06	53.92	56.05	56.54	56.87	57.07	57.23	55.96	440.71	605.64
EC5	7.91	7.79	8.10	8.27	8.12	8.18	8.25	8.09	64.44	110.17
TEC	237.11	222.66	310.92	344.62	325.57	329.36	343.25	301.78	2325.84	3339.26
HPEC	.0232	.0237	.0247	.0240	.0248	.0250	.0246	.0244		
PHU	.21%	6.07%	-7.51%	-5.32%	-5.63%	-8.95%	-7.12%	-7.65%		
COP	2.232	2.183	2.093	2.163	2.086	2.075	2.107	2.112		
LMTD	.6317	.6323	.8858	1.0436	.8880	1.0536	1.1583	.9001		
U	1.02	.97	1.01	.97	.88	.87	.85	.93		

Table H.54; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 25 May 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	25 May	26 May	27 May	28 May	29 May	30 May	31 May		
HT1	316.7	331.3	271.3	260.9	224.8	251.3	318.7	289.0	3.875E+4
HT2	373.1	390.3	212.6	245.1	202.2	227.4	291.8	281.0	3.862E+4
HT3	257.4	249.6	163.4	240.0	220.9	250.9	293.8	239.7	3.226E+4
HT4	469.1	458.5	291.5	317.1	288.8	362.5	404.5	369.9	5.132E+4
HT5	498.7	491.8	297.8	338.4	347.9	439.4	435.4	412.2	5.640E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	257.40	246.45	161.50	164.00	140.29	231.86	223.91	203.63	1201.50
EC3	14.64	14.18	10.89	14.26	12.35	13.56	14.34	13.46	79.89
EC4	57.36	55.09	75.47	62.39	47.91	54.86	55.34	58.35	353.09
EC5	8.48	8.12	8.10	8.13	7.16	8.37	8.43	8.11	48.36
TEC	337.88	323.84	255.97	248.79	207.71	308.65	302.03	283.55	1682.84
HPEC	.0229	.0234	.0231	.0216	.0231	.0262	.0231	.0234	
PHU	-6.31%	-7.28%	-2.17%	-6.72%	-20.45%	-19.25%	-7.63%	-11.43%	
COP	2.266	2.216	2.244	2.404	2.240	1.976	2.246	2.205	
LMTD	1.1125	1.1901	1.4572	.8387	.7730	.8815	.9999	1.0446	
U	.80	.78	.52	.87	.82	.90	.89	.78	

Table H-55; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 1 Jun 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	1 Jun	2 Jun	3 Jun	4 Jun	5 Jun	6 Jun	7 Jun			
HT1	322.1	0.0	292.9	247.7	245.5	255.3	253.8	263.4	3.685E+4	7.560E+4
HT2	290.3	0.0	268.5	232.4	223.0	234.5	229.1	242.6	3.374E+4	7.236E+4
HT3	239.7	0.0	307.8	307.6	311.0	307.1	278.3	298.1	4.006E+4	7.232E+4
HT4	344.2	0.0	441.4	418.8	447.8	442.8	394.9	421.2	5.648E+4	1.078E+5
HT5	418.1	0.0	475.6	435.9	484.0	478.9	407.2	450.4	6.049E+4	1.169E+5
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	73.27	0.00	221.31	235.92	258.94	119.05	230.95	162.78	1363.35	2564.85
EC3	4.98	0.00	12.41	12.92	14.17	6.45	13.04	9.14	78.31	158.20
EC4	18.54	0.00	48.40	55.52	55.55	29.57	76.92	40.64	339.84	692.93
EC5	2.79	0.00	7.35	8.39	8.44	3.87	8.04	5.55	47.30	95.67
TEC	99.58	0.00	289.46	312.75	337.10	158.93	328.95	218.11	1828.81	3511.65
HPEC	.0266	0.0000	.0239	.0235	.0241	.0244	.0254	.0241		
PHU	-21.50%	0.00%	-7.74%	-4.08%	-8.10%	-8.15%	-3.10%	-6.94%		
COP	1.947	0.000	2.170	2.207	2.150	2.119	2.037	2.125		
LMTD	.9774	0.0000	.9948	.9975	.8705	.9215	.9795	.9636		
U	.93	0.00	.83	.70	.79	.78	.73	.77		

Table H-56;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 8 Jun 1985

	1	2	3	4	5	6	7	AVE	TOTAL
	8 Jun	9 Jun	10 Jun	11 Jun	12 Jun	13 Jun	14 Jun		
HT1	296.9	236.6	247.4	298.7	282.1	215.6	286.4	264.7	3.198E+4
HT2	273.0	218.4	227.3	276.6	263.1	204.5	268.6	247.0	2.971E+4
HT3	294.8	304.7	299.4	286.3	297.9	350.7	326.0	310.7	3.776E+4
HT4	433.3	447.7	441.5	415.5	433.1	491.2	466.6	448.3	5.471E+4
HT5	471.2	480.9	476.0	386.8	352.9	427.0	403.2	421.5	5.232E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	99.96	198.85	261.91	253.26	262.79	256.35	259.04	227.45	1333.12
EC3	5.28	10.24	13.67	14.27	14.33	12.28	13.79	11.98	70.07
EC4	30.04	60.17	80.50	80.47	57.53	76.47	80.58	66.54	385.18
EC5	3.15	6.32	8.41	8.42	8.48	8.49	8.49	7.39	43.27
TEC	138.43	275.58	364.49	356.42	343.14	353.59	361.89	313.36	1831.64
HPEC	.0256	.0247	.0247	.0254	.0253	.0217	.0231	.0244	
PHU	-8.73%	-7.42%	-7.82%	6.92%	18.52%	13.06%	13.59%	5.98%	
COP	2.021	2.099	2.095	2.040	2.049	2.382	2.239	2.144	
LMTD	1.0917	.9530	1.0059	1.1763	1.1325	1.0636	1.2292	1.1061	
U	.76	.70	.69	.71	.70	.57	.65	.67	

Table H-57;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 15 Jun 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	15 Jun	16 Jun	17 Jun	18 Jun	19 Jun	20 Jun	21 Jun			
HT1	310.7	302.1	287.0	228.4	239.1	259.6	222.9	265.2	5.127E+4	8.325E+4
HT2	293.4	281.8	268.3	208.9	222.0	242.3	208.5	246.2	4.785E+4	7.755E+4
HT3	336.0	330.1	324.2	336.6	332.1	323.4	334.6	331.5	6.343E+4	1.012E+5
HT4	473.7	471.9	469.3	448.6	471.5	467.1	479.5	468.8	8.995E+4	1.447E+5
HT5	411.7	411.8	410.4	387.1	396.0	395.0	406.7	402.6	7.732E+4	1.296E+5
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	256.04	252.65	256.41	232.20	256.97	254.10	259.69	252.58	2027.11	3360.23
EC3	13.51	13.16	13.08	12.19	13.25	13.06	12.44	12.96	104.48	174.55
EC4	80.76	80.67	81.03	79.06	78.05	77.21	77.07	79.12	634.44	1019.62
EC5	8.48	8.48	8.48	8.45	8.48	8.48	8.49	8.48	67.83	111.10
TEC	358.80	354.97	359.00	331.90	356.75	352.86	357.69	353.14	2833.85	4665.49
HPEC	.0225	.0223	.0228	.0216	.0227	.0227	.0226	.0225		
PHU	13.09%	12.74%	12.55%	13.71%	16.02%	15.43%	15.16%	14.11%		
COP	2.300	2.322	2.275	2.402	2.281	2.285	2.295	2.307		
LMTD	1.3746	1.4080	1.3808	1.2043	1.1643	1.2955	1.2271	1.2987		
U	.63	.60	.58	.53	.58	.56	.51	.57		

Table H-58;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 22 Jun 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	22 Jun	23 Jun	24 Jun	25 Jun	26 Jun	27 Jun	28 Jun		
HT1	246.4	197.9	189.7	129.1	232.2	221.2	236.5	205.8	2.895E+4
HT2	229.6	189.9	243.5	278.8	225.3	213.0	231.0	230.0	3.289E+4
HT3	311.2	312.9	271.8	247.1	336.2	334.7	321.2	305.2	4.322E+4
HT4	460.6	457.4	422.4	472.0	472.7	474.3	464.1	460.4	6.576E+4
HT5	384.5	383.8	336.7	404.2	406.9	403.2	395.8	386.2	5.528E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	249.04	258.44	225.66	240.58	243.62	248.93	249.98	245.18	1466.27
EC3	12.64	13.48	13.80	16.17	13.06	12.96	13.32	13.63	82.11
EC4	73.73	76.98	77.19	77.48	77.47	77.41	77.65	76.84	460.25
EC5	8.13	8.48	8.43	8.51	8.51	8.53	8.52	8.44	50.59
TEC	343.53	357.37	325.08	342.74	342.67	347.83	349.47	344.10	2059.21
HPEC	.0235	.0235	.0223	.0212	.0215	.0219	.0224	.0223	
PHU	16.53%	16.09%	20.28%	14.38%	13.94%	14.99%	16.88%	16.12%	
COP	2.204	2.200	2.327	2.439	2.412	2.369	2.308	2.321	
LMTD	1.2426	1.0536	.9015	.9051	.8906	.9042	.9452	.9903	
U	.56	.53	.59	.40	.73	.69	.70	.58	

Table H-59;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 29 Jun 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	29 Jun	30 Jun	1 Jul	2 Jul	3 Jul	4 Jul	5 Jul			
HT1	246.1	251.7	274.9	255.5	260.4	259.6	285.2	264.3	4.859E+4	7.754E+4
HT2	239.4	246.4	268.4	246.9	251.4	245.9	280.3	255.3	4.717E+4	8.006E+4
HT3	319.6	316.0	310.0	311.8	309.3	306.4	291.9	312.4	5.846E+4	1.017E+5
HT4	466.3	459.5	458.5	453.9	452.4	454.5	432.9	454.2	8.563E+4	1.514E+5
HT5	389.5	380.0	376.6	370.2	373.3	371.3	344.6	372.4	7.035E+4	1.256E+5
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	249.49	240.13	256.86	250.53	240.13	250.81	226.22	244.88	1964.14	3430.41
EC3	13.06	12.54	13.01	12.73	11.65	12.27	12.48	12.56	101.26	183.37
EC4	77.72	74.36	77.79	77.74	74.33	77.42	71.03	75.77	608.03	1068.28
EC5	8.54	8.18	8.55	8.54	8.16	8.51	7.91	8.34	66.91	117.51
TEC	348.81	335.20	356.21	349.53	334.48	349.01	317.63	341.55	2740.35	4799.56
HPEC	.0223	.0227	.0233	.0230	.0231	.0230	.0238	.0229		
PHU	16.47%	17.31%	17.86%	18.43%	17.48%	18.31%	20.39%	18.01%		
COP	2.324	2.280	2.219	2.252	2.245	2.253	2.181	2.251		
LMTD	1.0269	1.0770	1.2063	1.2013	1.2917	1.3231	1.2830	1.2020		
U	.67	.66	.64	.60	.57	.55	.62	.62		

Table H-60; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 6 Jul 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	6 Jul	7 Jul	8 Jul	9 Jul	10 Jul	11 Jul	12 Jul		
HT1	235.8	247.8	249.2	259.2	250.5	251.3	227.7	246.3	3.440E+4
HT2	227.7	234.6	236.3	243.1	263.8	219.9	208.7	233.3	3.279E+4
HT3	255.9	307.7	310.3	312.0	278.7	310.2	307.2	298.3	4.093E+4
HT4	393.9	441.0	450.1	451.6	459.2	458.9	450.9	444.3	6.119E+4
HT5	296.2	326.0	341.2	339.4	348.1	348.4	343.2	335.2	4.610E+4
EC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC2	197.39	221.09	246.63	253.66	244.91	256.61	244.98	237.89	1420.29
EC3	9.70	11.02	12.03	12.15	11.92	12.10	11.49	11.49	68.91
EC4	88.90	95.13	103.72	86.20	74.10	77.26	74.09	85.63	525.31
EC5	6.76	7.77	8.52	8.50	8.14	8.51	8.13	8.05	48.20
TEC	302.75	335.01	370.91	360.50	339.07	354.48	338.70	343.06	2062.71
HPEC	.0239	.0228	.0228	.0234	.0232	.0233	.0236	.0232	
PHU	24.80%	26.07%	24.18%	24.84%	24.20%	24.08%	23.88%	24.56%	
COP	2.171	2.273	2.269	2.213	2.234	2.223	2.193	2.225	
LMTD	1.2101	1.1647	1.2172	1.2812	1.3195	1.3212	1.2451	1.2546	
U	.55	.60	.57	.57	.53	.53	.51	.55	

Table H-61; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 13 Jul 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	13 Jul	14 Jul	15 Jul	16 Jul	17 Jul	18 Jul	19 Jul			
HT1	220.5	216.2	9.5	74.5	273.7	250.5	321.5	177.8	3.748E+4	7.188E+4
HT2	206.0	200.4	34.1	210.0	257.9	221.5	305.0	195.4	3.872E+4	7.151E+4
HT3	302.5	298.4	108.9	103.3	356.7	314.3	362.8	257.8	5.068E+4	9.161E+4
HT4	449.8	446.7	106.3	310.3	495.4	470.5	502.2	390.3	7.613E+4	1.373E+5
HT5	341.2	332.6	78.0	241.4	392.5	358.4	413.6	294.4	5.889E+4	1.050E+5
EC1	0.00	0.00	0.00	0.00	22.75	59.72	75.59	20.60	158.06	158.06
EC2	253.25	257.27	107.16	178.52	233.63	238.66	263.57	218.87	1777.04	3197.32
EC3	11.93	11.77	6.54	12.72	11.74	12.20	14.12	11.57	92.51	161.42
EC4	77.42	77.27	77.42	77.47	71.72	78.45	78.44	76.88	612.27	1137.59
EC5	8.47	6.47	3.65	7.08	7.76	8.47	8.51	7.49	60.55	108.75
TEC	351.06	354.77	194.76	275.79	347.61	397.50	440.24	335.41	2700.43	4763.14
HPEC	.0235	.0240	.0420	.0240	.0214	.0211	.0219	.0233		
PHU	24.14%	25.54%	26.64%	22.21%	20.77%	23.82%	17.64%	22.59%		
COP	2.208	2.159	1.234	2.161	2.416	2.451	2.369	2.135		
LMTD	1.2398	1.2671	0.0000	0.0000	.6373	.5512	.5970	.7745		
U	.50	.48	0.00	0.00	1.21	1.28	1.51	.64		

Table H-62;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 20 Jul 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	20 Jul	21 Jul	22 Jul	23 Jul	24 Jul	25 Jul	26 Jul		
HT1	376.3	341.6	299.2	306.7	357.4	399.4	405.6	356.1	4.792E+4
HT2	358.9	321.7	283.2	288.4	338.0	382.3	385.2	337.7	4.543E+4
HT3	359.7	340.2	361.9	361.9	356.1	344.7	351.1	353.4	4.883E+4
HT4	502.0	478.5	497.7	496.5	492.8	485.0	490.7	491.7	6.787E+4
HT5	408.2	373.5	402.6	382.4	372.5	365.4	383.8	383.5	5.293E+4
EC1	67.22	73.33	65.48	67.01	67.29	70.26	72.18	68.95	410.58
EC2	239.94	248.48	237.16	246.90	249.25	255.17	257.19	247.73	1476.90
EC3	12.85	13.35	12.74	13.24	13.19	13.80	13.75	13.27	79.17
EC4	71.94	78.36	71.77	75.06	75.09	79.37	78.59	75.74	451.59
EC5	7.81	8.50	7.81	8.14	8.16	8.52	8.54	8.21	46.94
TEC	399.76	422.02	394.95	410.36	412.99	427.11	430.24	413.90	2467.18
HPEC	.0217	.0216	.0217	.0216	.0220	.0219	.0218	.0218	
PHU	18.70%	21.94%	19.11%	22.98%	24.42%	24.66%	21.80%	22.00%	
COP	2.384	2.394	2.392	2.396	2.356	2.363	2.372	2.379	
LMTD	.7158	.7199	.6618	.7057	.8368	.9560	.9970	.8023	
U	1.48	1.33	1.27	1.22	1.20	1.17	1.14	1.25	

Table H-63;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 27 Jul 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	27 Jul	28 Jul	29 Jul	30 Jul	31 Jul	1 Aug	2 Aug			
HT1	401.0	390.1	341.4	316.0	313.4	272.5	275.2	329.6	6.516E+4	1.131E+5
HT2	383.0	373.2	324.4	297.7	296.1	257.0	259.6	311.8	6.183E+4	1.073E+5
HT3	353.8	351.0	349.7	350.0	347.9	349.0	350.7	350.3	6.728E+4	1.161E+5
HT4	492.6	492.8	492.8	491.7	489.8	492.7	487.0	491.3	9.432E+4	1.622E+5
HT5	391.6	390.0	384.0	386.4	386.0	390.1	385.1	387.5	7.433E+4	1.273E+5
EC1	73.83	73.94	73.20	70.95	70.87	70.89	71.38	72.14	577.25	987.83
EC2	261.64	262.24	264.63	264.91	264.21	261.64	263.75	263.29	2100.21	3577.10
EC3	13.71	13.60	13.55	13.43	13.38	13.29	13.22	13.45	107.92	187.10
EC4	78.60	78.50	78.44	78.41	78.37	78.22	78.19	78.39	627.31	1078.90
EC5	8.53	8.55	8.52	8.50	8.51	8.52	8.50	8.52	68.16	117.10
TEC	436.31	436.83	438.34	436.21	435.33	432.54	435.04	435.79	3480.85	5948.03
HPEC	.0221	.0222	.0224	.0224	.0225	.0221	.0226	.0223		
PHU	20.50%	20.86%	22.08%	21.42%	21.19%	20.83%	20.93%	21.12%		
COP	2.340	2.336	2.315	2.308	2.305	2.341	2.296	2.320		
LMTD	1.0334	1.0647	.9999	.9917	1.0113	.9350	.9591	.9995		
U	1.09	1.03	.96	.89	.87	.82	.81	.93		

Table H-64;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 3 Aug 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	3 Aug	4 Aug	5 Aug	6 Aug	6 Aug	7 Aug	8 Aug		
HT1	256.4	272.7	312.2	242.1	497.2	504.8	504.4	369.5	4.955E+4
HT2	241.2	257.1	293.0	485.1	467.6	474.0	474.9	378.1	5.251E+4
HT3	345.8	343.5	331.0	182.3	354.3	352.3	347.7	323.3	4.529E+4
HT4	489.2	487.1	473.4	484.7	494.1	492.8	488.7	487.1	6.914E+4
HT5	390.3	389.0	375.4	377.7	420.6	418.4	408.7	397.5	5.615E+4
EC1	67.91	70.78	71.15	60.19	65.33	65.54	62.00	66.98	400.91
EC2	254.03	264.81	270.40	252.26	262.33	262.56	265.17	261.65	1566.39
EC3	12.59	13.01	13.30	14.00	14.15	14.21	14.40	13.66	81.25
EC4	74.73	77.90	77.76	74.30	77.47	77.24	77.13	76.65	459.40
EC5	8.15	8.52	8.49	8.13	8.54	8.55	8.53	8.41	50.37
TEC	417.41	435.01	441.10	408.88	427.83	428.10	427.24	427.26	2558.32
HPEC	.0226	.0227	.0238	.0226	.0221	.0222	.0226	.0227	
PHU	20.22%	20.14%	20.69%	22.07%	14.86%	15.10%	16.36%	18.39%	
COP	2.294	2.287	2.176	2.289	2.341	2.333	2.291	2.287	
LMTD	.9396	1.0588	1.1449	1.0178	.7767	.8248	.8485	.9666	
U	.77	.72	.77	.67	1.80	1.72	1.67	1.07	

Table H-65;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 10 Aug 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	9 Aug	10 Aug	11 Aug	12 Aug	13 Aug	14 Aug	15 Aug			
HT1	511.0	449.7	447.6	428.3	457.5	410.6	356.4	439.9	8.294E+4	1.325E+5
HT2	479.7	434.7	419.5	388.1	432.3	384.0	336.4	412.4	7.793E+4	1.304E+5
HT3	325.4	301.6	319.9	290.4	329.5	344.7	355.3	324.0	6.041E+4	1.057E+5
HT4	475.0	451.6	466.7	426.8	469.9	492.4	490.6	467.3	8.698E+4	1.561E+5
HT5	401.4	369.2	391.9	360.2	402.0	430.8	434.6	397.7	7.388E+4	1.300E+5
EC1	49.05	48.82	49.12	43.40	48.91	48.43	38.01	46.53	387.74	788.65
EC2	253.67	253.38	265.42	222.15	266.29	267.07	211.56	248.51	2004.72	3571.11
EC3	14.55	13.78	14.32	12.36	14.03	13.77	10.51	13.33	107.73	188.97
EC4	77.04	76.91	76.93	70.17	76.08	75.81	59.39	73.19	529.46	1048.86
EC5	8.54	8.53	8.53	7.80	8.49	8.46	6.71	8.15	65.57	115.94
TEC	402.86	401.42	414.31	355.87	413.80	413.54	326.18	389.71	3155.22	5713.54
HPEC	.0223	.0234	.0237	.0237	.0236	.0226	.0227	.0230		
PHU	15.50%	18.25%	16.04%	15.60%	14.45%	12.51%	11.41%	14.91%		
COP	2.328	2.216	2.186	2.189	2.194	2.292	2.282	2.241		
LMTD	.8841	.9813	.9170	.9706	1.1084	1.1150	1.0811	1.0104		
U	1.62	1.29	1.37	1.24	1.16	1.03	.93	1.22		

Table H-66; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 16 Aug 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	16 Aug	17 Aug	18 Aug	19 Aug	20 Aug	21 Aug	22 Aug		
HT1	353.2	324.2	293.2	252.2	255.4	252.9	297.9	289.6	4.097E+4
HT2	329.6	308.1	276.5	232.6	243.2	240.4	284.8	273.6	3.859E+4
HT3	351.8	345.1	337.7	331.9	344.9	345.0	354.3	344.8	4.868E+4
HT4	499.5	496.3	482.9	470.7	484.9	484.8	496.7	488.1	6.910E+4
HT5	434.5	431.3	410.6	402.4	406.2	407.4	425.1	416.7	5.398E+4
EC1	47.19	43.97	46.05	45.41	46.09	46.13	46.48	45.92	274.84
EC2	264.41	252.57	262.84	237.65	261.15	251.21	253.82	254.81	1529.83
EC3	13.11	12.19	12.95	11.93	13.03	12.73	13.01	12.71	75.94
EC4	74.80	72.05	74.54	71.05	74.19	74.09	74.00	73.53	440.73
EC5	8.47	8.13	8.47	7.75	8.48	8.51	8.52	8.33	49.80
TEC	407.97	388.91	404.85	373.80	402.94	392.67	395.83	395.30	2371.14
HPEC	.0221	.0221	.0227	.0220	.0224	.0216	.0213	.0221	
PHU	13.01%	13.10%	14.97%	14.52%	16.24%	15.98%	14.42%	14.62%	
COP	2.349	2.341	2.284	2.360	2.309	2.399	2.433	2.353	
LMTD	1.1827	1.2249	1.1536	.9921	1.0709	1.0545	1.0089	1.0930	
U	.84	.74	.71	.71	.67	.67	.83	.74	

Table H-67; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 23 Aug 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	23 Aug	24 Aug	25 Aug	26 Aug	27 Aug	28 Aug	29 Aug			
HT1	349.0	368.4	352.4	346.3	361.5	398.8	417.0	370.5	6.864E+4	1.096E+5
HT2	329.4	349.4	350.9	334.1	349.2	391.6	410.1	359.8	6.646E+4	1.051E+5
HT3	338.7	327.2	320.5	311.6	306.5	320.8	333.9	322.8	6.209E+4	1.108E+5
HT4	481.4	464.2	435.1	408.7	400.1	425.2	469.5	440.8	8.511E+4	1.542E+5
HT5	419.6	403.9	381.1	354.7	344.0	376.0	422.4	385.8	7.431E+4	1.333E+5
EC1	46.43	46.29	46.58	44.09	47.05	46.69	50.08	46.73	373.68	648.52
EC2	242.87	234.24	206.40	171.22	178.10	187.88	233.05	207.68	1707.58	3237.41
EC3	13.43	13.41	13.88	12.67	13.06	12.52	13.26	13.18	105.25	161.19
EC4	73.74	73.70	66.02	49.22	51.19	49.22	51.30	59.20	488.39	929.12
EC5	8.54	8.56	8.54	8.17	8.49	8.16	8.53	8.43	67.52	117.31
TEC	385.01	376.19	341.42	285.37	297.89	304.47	356.21	335.21	2742.41	5113.54
HPEC	.0210	.0210	.0198	.0182	.0185	.0192	.0207	.0201		
PHU	12.84%	13.00%	12.42%	13.22%	14.03%	11.57%	10.03%	12.48%		
COP	2.464	2.464	2.621	2.844	2.793	2.696	2.504	2.607		
LMTD	1.0885	1.1604	1.1872	1.1313	1.1738	1.2432	1.2986	1.1841		
U	.90	.89	.83	.86	.86	.90	.90	.88		

Table H-68

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 30 Aug 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	30 Aug	31 Aug	1 Sep	2 Sep	3 Sep	4 Sep	5 Sep		
HT1	403.5	407.9	409.9	423.7	461.2	509.5	542.8	452.0	6.157E+4
HT2	399.0	404.4	409.0	421.1	460.8	508.6	544.3	450.1	6.127E+4
HT3	315.6	320.5	304.8	306.5	306.2	337.7	344.3	319.3	4.444E+4
HT4	438.0	438.2	416.4	403.7	414.4	478.9	494.3	440.6	6.084E+4
HT5	387.8	391.4	370.0	368.1	382.0	434.9	451.6	397.9	5.686E+4
EC1	43.14	49.10	49.92	50.08	47.10	48.38	49.47	48.16	287.71
EC2	183.12	205.35	191.12	178.98	190.28	243.98	254.25	206.73	1192.94
EC3	11.60	13.22	13.18	13.20	13.14	13.31	13.28	12.99	77.65
EC4	44.90	51.34	51.09	50.85	50.89	50.79	50.76	50.09	299.87
EC5	7.47	8.55	8.53	8.54	8.53	8.53	8.52	8.38	50.15
TEC	290.22	327.56	313.85	301.66	309.93	365.00	376.27	326.35	1908.22
HPEC	.0199	.0195	.0191	.0185	.0191	.0212	.0214	.0196	
PHU	11.47%	10.70%	11.14%	8.81%	7.83%	9.18%	8.63%	9.69%	
COP	2.602	2.653	2.709	2.804	2.708	2.440	2.417	2.602	
LMTD	1.2935	1.3022	1.3131	1.3791	1.5059	1.5995	1.7459	1.4514	
U	.88	.88	.88	.86	.86	.89	.87	.87	

Table H-68,

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 6 Sep 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	6 Sep	7 Sep	8 Sep	9 Sep	10 Sep	11 Sep	12 Sep			
HT1	535.4	551.6	420.9	472.7	668.5	644.8	625.1	563.0	1.071E+5	1.686E+5
HT2	537.1	554.6	715.0	766.8	670.7	651.9	631.3	644.8	1.217E+5	1.830E+5
HT3	342.3	341.8	206.9	220.5	346.1	344.9	345.3	305.0	5.981E+4	1.043E+5
HT4	497.5	498.0	497.3	496.8	495.9	491.2	493.3	495.7	9.514E+4	1.560E+5
HT5	449.1	451.0	460.9	446.5	439.4	435.4	450.1	447.5	8.602E+4	1.409E+5
EC1	49.19	48.94	46.14	44.70	47.20	47.09	47.60	47.41	380.32	668.04
EC2	252.14	256.19	254.90	252.45	254.19	252.72	253.98	253.79	2030.81	3223.64
EC3	13.06	13.05	13.67	14.84	13.27	13.29	13.18	13.48	107.62	185.28
EC4	50.69	50.53	50.46	50.29	50.33	50.18	49.62	50.30	402.95	702.73
EC5	8.53	8.53	8.52	8.54	8.55	8.46	8.59	8.53	68.23	118.38
TEC	373.60	377.24	373.68	370.81	373.54	371.74	372.96	373.51	2989.84	4898.07
HPEC	.0211	.0214	.0214	.0212	.0214	.0214	.0215	.0213		
PHU	9.74%	9.44%	7.31%	10.12%	11.38%	11.37%	8.76%	9.73%		
COP	2.453	2.416	2.425	2.447	2.425	2.417	2.415	2.428		
LMTD	1.8079	1.9003	2.0037	2.0241	1.9245	1.9386	1.9525	1.9576		
U	.83	.82	.59	.66	.98	.93	.90	.81		

CLEARWATER MONITORING SYSTEM

Table H-70; CALCULATIONS FOR WEEK STARTING 13 Sep 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	13 Sep	14 Sep	15 Sep	16 Sep	17 Sep	18 Sep	19 Sep		
HT1	598.5	602.1	591.8	353.3	616.8	490.1	439.4	544.5	6.987E+4
HT2	606.1	607.6	599.0	963.2	614.8	727.6	568.8	645.3	8.282E+4
HT3	342.1	342.3	345.5	140.7	345.5	244.9	264.9	298.0	3.836E+4
HT4	493.4	499.2	496.2	495.9	496.9	494.3	502.9	497.0	6.200E+4
HT5	430.5	449.5	436.2	441.0	444.3	448.4	429.2	439.9	5.521E+4
EC1	46.78	44.70	45.18	29.42	70.95	62.29	61.15	52.03	299.33
EC2	252.81	244.28	212.15	127.32	253.29	236.04	229.04	222.13	1325.89
EC3	13.00	12.47	10.84	9.35	12.97	14.26	11.49	12.05	72.89
EC4	38.13	25.78	28.05	20.28	27.48	30.00	47.43	31.02	169.72
EC5	8.61	8.29	7.19	4.31	8.49	7.66	7.67	7.46	44.56
TEC	359.33	335.51	303.43	190.67	373.18	350.25	356.78	324.70	1912.38
HPEC	.0214	.0213	.0214	.0214	.0212	.0217	.0207	.0214	
PHU	12.75%	9.97%	12.08%	11.07%	10.59%	9.30%	14.67%	11.51%	
COP	2.426	2.435	2.423	2.421	2.439	2.387	2.502	2.434	
LMTD	1.9392	2.0533	2.1261	2.0528	2.3490	2.2741	1.8418	2.1219	
U	.87	.82	.78	.48	.74	.61	.67	.72	

CLEARWATER MONITORING SYSTEM

Table H-71; CALCULATIONS FOR WEEK STARTING 20 Sep 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	20 Sep	21 Sep	22 Sep	23 Sep	24 Sep	25 Sep	26 Sep			
HT1	446.5	489.1	377.3	766.3	730.2	700.4	688.2	595.2	1.104E+5	1.803E+5
HT2	640.1	473.2	689.8	756.4	719.0	689.4	678.6	661.9	1.240E+5	2.068E+5
HT3	256.0	347.9	193.9	331.9	333.8	341.6	333.3	307.0	5.715E+4	9.551E+4
HT4	513.3	514.7	485.7	465.8	473.7	484.6	480.8	488.4	9.311E+4	1.551E+5
HT5	467.9	461.2	417.2	401.4	411.3	431.9	431.2	431.5	8.197E+4	1.372E+5
EC1	67.54	69.92	64.41	72.73	72.50	71.40	71.36	70.37	551.02	850.35
EC2	261.98	260.24	251.00	244.93	245.31	251.59	250.08	252.16	1994.17	3320.06
EC3	13.15	12.36	13.68	13.89	13.46	13.31	13.14	13.28	104.48	177.37
EC4	51.80	51.82	51.70	51.23	42.73	25.18	25.12	42.79	346.99	516.71
EC5	8.35	8.38	8.36	8.34	8.37	8.38	8.36	8.36	66.20	110.76
TEC	402.82	402.71	389.16	391.11	382.37	369.85	368.07	386.98	3062.87	4975.25
HPEC	.0213	.0211	.0215	.0219	.0216	.0216	.0217	.0214		
PHU	8.85%	10.39%	14.09%	13.82%	13.19%	10.88%	10.32%	11.64%		
COP	2.436	2.459	2.405	2.364	2.401	2.395	2.390	2.408		
LMTD	1.9085	2.0043	1.8826	1.1948	1.2455	1.3067	1.4229	1.5923		
U	.66	.69	.56	1.80	1.65	1.51	1.36	1.05		

Table H-72; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 27 Sep 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	27 Sep	28 Sep	29 Sep	30 Sep	1 Oct	2 Oct	3 Oct		
HT1	676.1	658.4	650.7	469.7	688.5	638.8	585.7	628.9	9.010E+4
HT2	663.6	646.2	642.1	780.4	675.8	624.5	570.1	657.7	9.612E+4
HT3	319.2	333.0	331.8	205.0	338.1	335.3	339.0	314.3	4.438E+4
HT4	453.7	481.1	474.3	475.7	483.9	477.5	481.7	475.6	6.786E+4
HT5	389.6	429.7	408.5	425.8	434.1	416.5	428.4	419.0	5.971E+4
EC1	63.57	71.39	72.51	67.60	76.73	76.29	69.74	71.34	428.08
EC2	226.50	252.61	252.40	249.85	252.43	249.31	249.92	247.57	1483.10
EC3	12.38	13.04	13.20	13.54	13.27	13.53	13.28	13.18	78.96
EC4	23.76	24.67	24.45	24.11	19.04	.45	.42	16.70	116.48
EC5	8.01	8.37	8.37	8.34	8.35	8.33	8.35	8.30	49.76
TEC	334.22	370.09	370.92	363.43	369.82	347.91	341.71	357.09	2156.38
HPEC	.0217	.0219	.0222	.0219	.0217	.0218	.0216	.0219	
PHU	14.13%	10.68%	13.87%	10.50%	10.30%	12.77%	11.07%	11.88%	
COP	2.387	2.368	2.336	2.367	2.383	2.381	2.396	2.374	
LMTD	1.5387	1.6218	1.6941	1.7175	1.6935	1.6260	1.6156	1.6635	
U	1.23	1.14	1.08	.77	1.14	1.10	1.02	1.06	

Table H-73; CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 4 Oct 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	4 Oct	5 Oct	6 Oct	7 Oct	8 Oct	9 Oct	10 Oct			
HT1	561.2	559.9	566.4	561.8	586.8	556.4	545.5	562.7	1.080E+5	1.981E+5
HT2	552.8	552.7	551.2	549.5	575.6	547.5	532.9	551.9	1.058E+5	2.019E+5
HT3	331.6	333.8	331.4	328.0	321.7	328.2	320.3	327.9	6.289E+4	1.073E+5
HT4	478.1	476.9	471.5	465.9	461.4	458.6	447.3	465.7	8.933E+4	1.572E+5
HT5	422.3	417.4	412.0	409.5	417.2	406.6	395.4	411.5	7.901E+4	1.387E+5
EC1	70.20	70.07	71.23	68.22	71.25	71.14	70.84	70.42	562.69	990.77
EC2	248.04	248.07	248.73	239.54	246.32	248.21	239.37	245.47	1968.21	3451.30
EC3	13.45	13.37	13.28	12.68	13.36	13.04	13.14	13.19	105.60	184.56
EC4	.47	.48	.42	.42	.45	.33	.34	.42	3.38	119.86
EC5	8.35	8.36	8.35	8.02	8.38	8.36	8.36	8.31	66.52	116.29
TEC	340.51	340.36	342.01	328.87	339.76	341.14	332.05	337.81	2706.40	4862.78
HPEC	.0216	.0217	.0220	.0224	.0222	.0226	.0223	.0220		
PHU	11.66%	12.47%	12.62%	12.10%	9.57%	11.34%	11.60%	11.64%		
COP	2.396	2.390	2.356	2.317	2.329	2.297	2.323	2.345		
LMTD	1.6197	1.6766	1.7634	1.7917	1.7268	1.7420	1.7469	1.7245		
U	.97	.94	.90	.88	.95	.90	.88	.92		

CLEARWATER MONITORING SYSTEM
Table H-74; CALCULATIONS FOR WEEK STARTING 11 Oct 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	11 Oct	12 Oct	13 Oct	14 Oct	15 Oct	16 Oct	17 Oct		
HT1	421.0	490.1	464.8	437.7	417.4	393.3	417.8	436.2	6.217E+4
HT2	388.4	485.9	464.5	434.8	416.0	394.9	413.0	430.4	6.124E+4
HT3	236.5	259.6	259.8	260.7	268.2	294.8	202.7	254.9	3.738E+4
HT4	303.1	342.9	341.6	342.4	354.3	405.7	263.0	335.5	4.945E+4
HT5	285.1	305.7	305.6	301.6	322.8	361.5	253.5	304.6	4.453E+4
EC1	56.64	66.86	68.00	68.52	73.42	67.75	75.24	67.90	401.19
EC2	141.61	157.92	158.57	158.02	170.73	205.54	128.27	160.09	992.38
EC3	11.73	13.69	13.63	13.56	13.50	12.96	13.02	13.16	79.07
EC4	.37	.44	.43	.41	.37	12.76	42.44	8.17	14.78
EC5	7.72	8.61	8.61	8.63	8.69	8.29	8.54	8.44	50.55
TEC	218.06	247.52	249.25	249.14	266.71	307.29	267.52	257.76	1537.97
HPEC	.0203	.0192	.0193	.0192	.0201	.0220	.0203	.0201	
PHU	5.93%	10.87%	10.55%	11.92%	8.90%	10.89%	3.61%	9.19%	
COP	2.550	2.700	2.678	2.694	2.580	2.352	2.549	2.574	
LMTD	1.5986	1.4070	1.3729	1.3438	1.3281	1.2998	1.3963	1.3923	
U	.74	.98	.95	.91	.88	.85	.84	.88	

CLEARWATER MONITORING SYSTEM
Table H-75; CALCULATIONS FOR WEEK STARTING 18 Oct 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	18 Oct	19 Oct	20 Oct	21 Oct	22 Oct	23 Oct	24 Oct			
HT1	434.5	430.4	357.8	238.2	496.6	492.9	548.7	427.3	8.201E+4	1.442E+5
HT2	432.1	430.0	349.5	412.1	495.2	506.1	546.9	451.8	8.604E+4	1.473E+5
HT3	219.6	214.4	166.7	93.4	183.6	185.7	223.8	184.4	3.576E+4	7.314E+4
HT4	281.8	278.8	214.8	193.7	234.8	228.4	290.6	245.6	4.766E+4	9.712E+4
HT5	273.1	268.8	196.7	172.0	217.1	213.5	259.8	231.1	4.451E+4	8.904E+4
EC1	72.67	72.25	73.13	65.46	75.34	75.05	75.68	73.20	584.82	986.02
EC2	135.44	134.75	110.24	89.22	122.30	105.41	137.55	119.27	963.17	1955.55
EC3	13.07	13.04	12.71	12.70	13.79	13.89	14.16	13.34	106.39	185.46
EC4	42.60	42.68	42.51	42.18	41.26	40.76	40.76	41.82	335.19	349.97
EC5	8.61	8.56	8.43	8.33	8.33	8.08	8.26	8.37	67.13	117.68
TEC	272.39	271.28	247.02	217.88	261.02	243.19	276.41	256.00	2056.71	3594.68
HPEC	.0200	.0201	.0214	.0192	.0217	.0192	.0197	.0202		
PHU	3.10%	3.60%	8.45%	11.21%	7.53%	6.52%	10.59%	5.92%		
COP	2.587	2.573	2.423	2.699	2.387	2.694	2.627	2.560		
LMTD	1.4512	1.4920	1.4079	1.0798	.9157	.9574	1.0393	1.1982		
U	.84	.81	.71	.62	1.52	1.45	1.48	1.00		

Table H-76;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 25 Oct 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	25 Oct	26 Oct	27 Oct	28 Oct	29 Oct	30 Oct	31 Oct		
HT1	485.9	321.0	278.8	189.0	325.0	365.8	367.1	352.4	4.669E+4
HT2	488.2	312.7	286.4	110.7	322.2	364.1	366.0	331.1	4.473E+4
HT3	207.1	167.7	150.5	45.1	183.6	183.4	184.7	162.6	2.229E+4
HT4	258.3	202.9	200.3	109.9	208.0	212.2	215.6	200.2	2.834E+4
HT5	219.8	167.1	184.6	93.8	168.7	189.4	179.1	171.3	2.434E+4
EC1	71.23	64.86	64.41	54.43	76.66	80.93	103.80	74.42	412.52
EC2	112.03	92.07	87.49	50.53	85.16	88.18	87.59	86.15	515.46
EC3	12.89	11.65	10.66	7.51	13.97	14.57	14.50	12.25	71.25
EC4	39.18	40.92	40.75	40.54	39.93	34.13	24.90	37.19	235.45
EC5	7.94	8.10	8.14	8.03	8.03	8.03	8.04	8.04	48.27
TEC	243.26	217.59	211.45	161.04	223.75	225.85	238.82	218.06	1282.95
HPEC	.0189	.0189	.0182	.0192	.0171	.0173	.0169	.0182	
PHU	14.89%	17.63%	7.85%	14.67%	18.91%	10.71%	16.94%	14.43%	
COP	2.747	2.739	2.846	2.703	3.037	2.991	3.061	2.872	
LMTD	1.0517	1.0057	1.3273	.9906	.6147	.6806	.7199	.9367	
U	1.30	.90	.59	.54	1.48	1.51	1.43	1.06	

Table H-77;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 1 Nov 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-
DATE	1 Nov	2 Nov	3 Nov	4 Nov	5 Nov	6 Nov	7 Nov			
HT1	425.8	460.4	420.6	429.5	459.9	352.0	485.9	434.1	8.163E+4	1.283
HT2	424.8	459.1	412.0	430.2	461.4	304.0	484.3	424.3	8.021E+4	1.249
HT3	208.2	228.3	201.7	226.5	224.8	130.9	266.6	210.8	4.012E+4	6.241
HT4	252.9	290.9	258.5	289.1	287.3	194.4	341.3	272.5	5.112E+4	7.946
HT5	226.5	273.4	247.5	287.5	288.3	167.5	318.0	257.5	4.770E+4	7.205
EC1	99.42	100.21	97.71	105.21	105.74	90.08	103.71	100.31	805.89	1218.
EC2	111.24	137.37	119.43	137.43	136.26	96.18	159.99	128.27	985.49	1500.
EC3	14.34	14.32	13.70	14.19	14.12	10.61	14.05	13.62	109.84	181.
EC4	24.28	23.41	23.29	22.64	21.09	20.02	19.40	22.02	179.02	414.
EC5	8.17	8.36	8.21	8.37	8.34	7.77	8.25	8.21	65.52	113.
TEC	257.46	283.68	262.35	287.84	285.55	224.65	305.41	272.43	2145.75	3428.
HPEC	.0183	.0197	.0193	.0198	.0198	.0206	.0195	.0193		
PHU	10.46%	6.03%	4.27%	.58%	-.35%	13.86%	6.84%	5.49%		
COP	2.827	2.633	2.691	2.616	2.621	2.513	2.652	2.641		
LMTD	.8648	.9754	.9779	1.0066	1.1087	1.0949	1.2416	1.0415		
U	1.38	1.33	1.21	1.20	1.16	.90	1.10	1.17		

Table H-78; CLEARWATER MONITORING SYSTEM

CALCULATIONS FOR WEEK STARTING 8 Nov 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	8 Nov	9 Nov	10 Nov	11 Nov	12 Nov	13 Nov	14 Nov		
HT1	509.8	479.7	501.6	468.8	384.0	40.9	9.6	302.0	5.571E+4
HT2	513.8	504.8	526.4	489.8	373.7	.2	-.1	242.8	5.627E+4
HT3	243.3	189.3	188.3	190.3	110.0	-15.8	-20.4	94.1	2.100E+4
HT4	326.6	287.6	287.2	285.7	321.7	411.6	140.6	315.9	4.511E+4
HT5	249.3	36.0	50.8	51.7	44.8	0.0	0.0	41.4	9.635E+3
EC1	90.89	103.11	102.71	102.30	96.23	59.46	88.08	93.92	554.70
EC2	135.35	139.46	140.17	139.60	110.95	1.48	1.14	95.45	667.02
EC3	12.25	13.99	13.93	13.88	11.00	.17	.17	9.34	65.21
EC4	16.71	19.52	19.38	18.89	14.23	.17	.11	12.72	88.90
EC5	7.21	8.15	8.17	8.16	6.50	.13	.11	5.49	38.31
TEC	262.41	284.22	284.36	282.83	238.91	61.40	89.61	216.91	1414.13
HPEC	.0197	.0202	.0203	.0204	.0144	.0002	.0003	.0148	
PHU	23.65%	87.49%	82.31%	81.92%	86.07%	100.00%	100.00%	86.88%	
COP	2.625	2.564	2.547	2.544	3.604	344.824	153.349	4.041	
LMTD	1.3353	1.2594	1.3681	1.3106	1.2619	0.0000	0.0000	.6704	
U	1.07	1.07	1.03	1.00	.85	0.00	0.00	1.27	

Table H-79; CLEARWATER MONITORING SYSTEM

CALCULATIONS FOR WEEK STARTING 15 Nov 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	15 Nov	16 Nov	17 Nov	18 Nov	19 Nov	20 Nov	21 Nov			
HT1	.1	.1	.1	10.3	1.2	0.0	0.0	9.6	5.134E+2	5.622E+4
HT2	-.2	.3	.2	.2	0.0	0.0	0.0	0.0	9.792E+0	5.628E+4
HT3	-.1	-.1	-.1	-10.5	-23.5	-0.0	-0.0	-8.8	-1.311E+3	1.969E+4
HT4	76.1	52.3	30.3	21.4	18.5	17.6	36.6	35.9	9.309E+3	5.442E+4
HT5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000E+0	9.635E+3
EC1	.82	.69	.72	55.61	97.71	.11	.27	50.14	244.01	798.71
EC2	1.75	1.86	1.07	1.05	1.24	1.19	1.12	1.33	10.42	677.43
EC3	.17	.17	.18	.17	.15	.16	.17	.17	1.34	66.55
EC4	.07	.09	.11	.09	.07	.11	.87	.20	1.52	90.43
EC5	.10	.09	.10	.10	.10	.11	.11	.10	.80	39.11
TEC	2.90	2.91	2.19	57.01	99.27	1.68	2.53	51.94	258.09	1672.22
HPEC	.0010	.0016	.0015	.0020	.0028	.0028	.0013	.0011		
PHU	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%		
COP	54.177	31.977	33.748	25.279	18.595	18.442	40.706	33.118		
LMTD	0.0000	.3729	.2829	0.0000	0.0000	0.0000	.2976	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Table H-80;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 22 Nov 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	22 Nov	23 Nov	24 Nov	25 Nov	26 Nov	27 Nov	28 Nov		
HT1	4.6	.2	.1	0.0	18.9	-2.2	-33.9	2.9	4.965E+2
HT2	0.0	0.0	0.0	0.0	.5	-.2	-.5	0.0	5.203E+0
HT3	-1.5	-.1	-.1	-0.0	-12.5	-30.3	1.2	-9.0	-1.052E+3
HT4	22.8	37.9	56.5	48.2	46.3	31.2	340.8	84.0	5.760E+3
HT5	0.0	0.0	0.0	0.0	0.0	0.0	-41.4	-.1	0.000E+0
EC1	21.03	1.66	.82	14.87	106.01	69.53	35.83	63.62	213.93
EC2	1.25	1.38	2.06	1.31	1.18	1.17	1.26	1.37	8.35
EC3	.17	.18	.19	.16	.15	.16	.16	.17	1.01
EC4	41.00	47.84	40.78	14.94	6.78	27.08	48.72	32.45	178.42
EC5	.10	.12	.11	.10	.08	.09	.11	.10	.60
TEC	63.55	51.19	43.95	31.39	114.20	98.03	86.09	97.71	402.31
HPEC	.0024	.0015	.0015	.0011	.0011	.0016	.0002	.0014	
PHU	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	112.15%	100.17%	
COP	21.732	34.078	34.046	45.803	46.820	33.125	335.759	75.136	
LMTD	0.0000	0.0000	0.0000	.5617	0.0000	0.0000	0.0000	0.0000	
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table H-81;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 29 Nov 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	29 Nov	30 Nov	1 Dec	2 Dec	3 Dec	4 Dec	5 Dec			
HT1	-.2	-.5	-.4	-.5	-.4	-.3	-.2	-.4	-8.760E+2	-3.795E+2
HT2	.2	.3	.3	.4	.3	.4	.3	.3	3.783E+1	4.303E+1
HT3	0.0	.1	.1	.1	.1	.1	.1	.1	4.152E+1	-1.011E+3
HT4	97.2	45.0	18.8	96.2	84.2	47.4	41.8	61.5	1.851E+4	2.427E+4
HT5	-16.1	1.3	3.4	13.4	7.6	8.1	7.0	3.3	-4.016E+2	-4.016E+2
EC1	.21	.48	.49	.87	.47	.17	.12	.36	38.65	252.58
EC2	1.23	1.30	1.63	1.30	1.23	1.25	1.58	1.36	10.77	19.13
EC3	.16	.16	.18	.15	.18	.17	.16	.17	1.31	2.32
EC4	50.25	51.86	53.22	73.27	76.82	79.51	79.14	66.30	512.80	691.21
EC5	.10	.11	.11	.09	.09	.11	.11	.10	.83	1.43
TEC	51.95	53.91	55.63	75.68	78.79	81.21	81.11	68.29	564.37	966.68
HPEC	.0005	.0012	.0036	.0006	.0006	.0011	.0016	.0006		
PHU	116.53%	97.12%	82.02%	86.10%	91.00%	82.93%	83.18%	94.65%		
COP	98.595	43.003	14.337	91.942	85.409	46.966	32.949	56.261		
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Table H-82;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 6 Dec 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	6 Dec	7 Dec	8 Dec	9 Dec	10 Dec	11 Dec	12 Dec		
HT1	-.2	-.4	-.2	0.0	0.0	-24.9	.9	-84.4	-5.885E+2
HT2	.3	.3	.3	.3	-0.0	.5	18.4	1.1	3.515E+1
HT3	0.0	.1	0.0	0.0	0.0	-2.5	96.4	7.6	-5.272E+1
HT4	34.0	66.5	48.5	45.5	80.1	49.3	276.4	83.1	7.626E+3
HT5	5.8	7.7	6.9	7.5	15.3	12.6	147.0	27.1	1.314E+3
EC1	.09	.23	.09	0.00	0.00	19.10	62.43	35.95	19.50
EC2	1.42	1.56	1.55	1.33	1.31	3.83	60.68	10.24	11.01
EC3	.16	.18	.18	.17	.17	.65	7.30	1.26	1.51
EC4	76.42	76.68	79.71	80.05	53.61	51.71	47.47	66.52	418.19
EC5	.10	.10	.11	.11	.09	.41	6.97	1.13	.92
TEC	78.19	78.75	81.65	81.66	55.18	75.70	184.85	115.10	451.13
HPEC	.0018	.0010	.0013	.0012	.0007	.0034	.0105	.0014	
PHU	83.02%	88.40%	85.79%	83.54%	80.83%	74.48%	46.82%	67.43%	
COP	28.508	50.661	38.868	42.463	76.230	15.348	4.956	9.730	
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table H-83;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 13 Dec 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	13 Dec	14 Dec	15 Dec	16 Dec	17 Dec	18 Dec	19 Dec			
HT1	1.0	-58.6	0.0	0.0	0.0	0.0	-1.5	-163.4	-1.376E+3	-1.964E+3
HT2	22.2	15.1	.4	0.0	0.0	0.0	.2	10.2	1.286E+3	1.321E+3
HT3	99.3	26.9	0.0	0.0	0.0	0.0	-.2	12.3	5.054E+3	5.002E+3
HT4	277.4	165.5	-39.5	0.0	0.0	0.0	22.4	150.5	1.616E+4	2.379E+4
HT5	161.4	97.8	-3.0	0.0	0.0	0.0	6.9	83.3	9.333E+3	1.065E+4
EC1	64.73	64.87	0.00	0.00	0.00	0.00	.42	25.86	192.46	211.96
EC2	70.83	48.09	.98	0.00	0.00	0.00	.62	17.22	181.20	192.20
EC3	8.36	5.62	.10	0.00	0.00	0.00	.06	2.02	21.44	22.95
EC4	54.55	54.77	27.33	0.00	0.00	0.00	20.44	22.44	204.56	622.75
EC5	8.01	7.99	3.95	0.00	0.00	0.00	.03	2.85	26.95	27.87
TEC	206.49	181.35	32.36	0.00	0.00	0.00	21.57	70.40	626.61	1077.74
HPEC	.0106	.0121	0.0000	0.0000	0.0000	0.0000	.0030	.0112		
PHU	41.83%	40.91%	0.00%	0.00%	0.00%	0.00%	69.21%	44.62%		
COP	4.869	4.279	-25.101	0.000	0.000	0.000	16.987	4.462		
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Table H-84;

```
                         CLEARWATER MONITORING SYSTEM
                  CALCULATIONS FOR WEEK STARTING 20 Dec 1985

 DAY       1      2      3      4      5      6      7     AVE     TOTAL
DATE  20 Dec 21 Dec 22 Dec 23 Dec 24 Dec 25 Dec 26 Dec
 HT1     -.7   -1.0    -.8   -1.3   -1.0    -.3    -.6     -.8-1.204E+2
 HT2      .1     .1     .1     .1     .1     .1     .2      .1 1.501E+1
 HT3     -.1    -.1    -.1    -.1    -.1   -0.0    -.1     -.1-1.226E+1
 HT4   -92.1  -74.2  -82.6  -58.7  -67.1  -14.2   24.8   -51.5-9.149E+3
 HT5    -9.2   -9.3  -10.4   -6.1   -6.3   -1.2    3.6    -5.6-9.997E+2
 EC1     .46    .74    .65   1.20    .88    .26    .58     .68     4.18
 EC2    2.46   1.92   1.96   1.88   1.88   2.04   1.95    2.01    12.13
 EC3     .15    .17    .17    .17    .17    .17    .17     .17     1.01
 EC4   49.71  47.08  27.50  27.38  27.46  27.42  27.44   33.43   206.55
 EC5     .08    .09    .09    .09    .10    .10    .09     .09      .54
 TEC   52.86  50.00  30.38  30.71  30.48  29.99  30.24   36.38   224.42
HPEC 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000  .0033 0.0000
 PHU   0.00%  0.00%  0.00%  0.00%  0.00%  0.00% 85.70%   0.00%
 COP-42.699-48.136-52.398-38.765-44.395 -8.638 15.842-31.457
LMTD 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 U      0.00   0.00   0.00   0.00   0.00   0.00   0.00    0.00
```

Table H-85;

```
                         CLEARWATER MONITORING SYSTEM
                  CALCULATIONS FOR WEEK STARTING 27 Dec 1985

 DAY       8      9     10     11     12     13     14     AVE     TOTAL   2WK-TOT
DATE  27 Dec 28 Dec 29 Dec 30 Dec 31 Dec  1 Jan  2 Jan
 HT1     -.3    -.5    -.3    -.6    -.5    -.4    -.4     -.4-8.636E+1-2.067E+2
 HT2      .1     .1     .1     .1     .1     .1     .1      .1 2.228E+1 3.729E+1
 HT3    -0.0    -.1   -0.0    -.1    -.1   -0.0    -.1     -.1-1.111E+1-2.338E+1
 HT4   -18.3  -24.8   11.9  -30.1  -38.3  -25.2  -51.2   -25.1-3.627E+3-1.278E+4
 HT5     1.2   -0.0    5.8     .1   -1.0     .7   -3.4      .3 1.663E+2-8.334E+2
 EC1     .33    .58    .35    .52    .52    .37    .40     .44     3.66      7.84
 EC2    1.82   1.83   1.72   1.82   1.88   1.68   2.04    1.83    14.73     26.86
 EC3     .16    .16    .17    .17    .16    .18    .17     .17     1.34      2.35
 EC4   27.25  27.10  27.02  26.71  26.69  26.68  26.87   26.90   215.76    422.31
 EC5     .09    .08    .09    .09    .09    .10    .09     .09      .72      1.27
 TEC   29.65  29.76  29.34  29.30  29.33  29.02  29.57   29.43   236.21    460.63
HPEC 0.0000 0.0000  .0060 0.0000 0.0000 0.0000 0.0000 0.0000
 PHU   0.00%  0.00% 51.17%  0.00%  0.00%  0.00%  0.00%   0.00%
 COP-12.519-16.812  8.596-20.610-25.325-18.650-31.197-17.119
LMTD 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 U      0.00   0.00   0.00   0.00   0.00   0.00   0.00    0.00
```

Table H-86;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 3 Jan 1986

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	3 Jan	4 Jan	5 Jan	6 Jan	7 Jan	8 Jan	9 Jan		
HT1	-.3	-.8	-.6	-.8	-1.0	-.4	-0.0	-.5	-8.697E+1
HT2	.1	.1	.1	.2	.2	49.9	207.4	15.2	1.114E+3
HT3	-0.0	-.1	-.1	-.1	-.1	-0.0	0.0	-0.0	-9.506E+0
HT4	7.0	-23.0	-89.3	104.8	76.2	82.2	258.2	71.9	3.859E+3
HT5	1.8	-1.5	-14.8	4.8	4.1	39.6	90.3	23.6	8.015E+2
EC1	.25	.73	.47	.96	1.09	.66	.15	.61	4.16
EC2	1.96	1.74	1.37	1.43	1.54	23.65	70.32	14.57	31.67
EC3	.16	.18	.14	.14	.16	5.98	15.67	3.20	6.75
EC4	26.87	27.04	21.39	24.76	27.24	25.10	27.55	25.71	152.40
EC5	.09	.09	.06	.05	.05	3.14	8.14	1.66	3.48
TEC	29.32	29.77	23.43	27.33	30.08	58.52	121.83	45.75	198.45
HPEC	.0117	0.0000	0.0000	.0006	.0008	.0131	.0113	.0082	
PHU	73.91%	0.00%	0.00%	95.38%	94.66%	51.80%	65.04%	67.22%	
COP	4.426	-16.496	-64.267	83.749	61.534	3.961	4.565	5.803	
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table H-87;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 10 Jan 1986

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	10 Jan	11 Jan	12 Jan	13 Jan	14 Jan	15 Jan	16 Jan			
HT1	-0.0	0.0	-0.0	-0.0	0.0	-0.0	-.2	-0.0	-6.335E+0	-9.331E+1
HT2	276.4	295.1	275.8	295.1	320.9	306.7	44.8	248.7	4.819E+4	4.931E+4
HT3	0.0	0.0	0.0	0.0	0.0	0.0	-.1	0.0	-1.465E+0	-1.097E+1
HT4	254.2	245.6	234.6	199.5	158.3	115.4	63.1	200.9	3.643E+4	4.029E+4
HT5	120.3	144.2	146.5	147.6	169.0	136.7	10.5	128.2	2.300E+4	2.380E+4
EC1	.06	0.00	.01	.04	0.00	.05	.39	.07	.71	4.86
EC2	71.12	70.82	71.81	73.27	91.14	72.41	19.15	67.10	540.05	571.73
EC3	15.62	15.64	15.64	14.98	15.71	16.57	4.94	14.16	114.76	121.50
EC4	27.66	27.72	27.74	26.59	27.77	27.73	26.61	27.40	219.36	371.76
EC5	8.25	8.38	8.42	8.20	8.37	8.31	2.02	7.42	60.09	63.57
TEC	122.72	122.55	123.63	123.07	142.99	125.08	53.11	116.15	934.97	1133.42
HPEC	.0117	.0120	.0128	.0160	.0240	.0262	.0132	.0148		
PHU	52.70%	41.27%	37.56%	26.02%	-6.81%	-18.50%	83.40%	36.19%		
COP	4.444	4.311	4.061	3.244	2.159	1.980	3.927	3.677		
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Table H-88;

```
                  CLEARWATER MONITORING SYSTEM
             CALCULATIONS FOR WEEK STARTING 17 Jan 1986

 DAY      1      2      3      4      5      6      7    AVE    TOTAL
DATE 17 Jan 18 Jan 19 Jan 20 Jan 21 Jan 22 Jan 23 Jan
 HT1   -0.0    -.1    0.0    0.0   -0.0    0.0    0.0   -0.0-2.352E+0
 HT2  316.3  347.9  359.8  314.6  318.2  307.6  313.1  325.6 4.648E+4
 HT3    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0 7.200E-1
 HT4   98.4   98.4   98.8  107.7  106.0  107.7  104.7  103.2 1.461E+4
 HT5   72.6  100.6  115.6  121.8  119.7  122.0  118.2  125.0 1.548E+4
 EC1    .02    .28   0.00   0.00    .23   0.00   0.00    .08     .54
 EC2  69.63  70.39  75.95  75.08  75.72  76.85  75.29  74.13  443.62
 EC3  15.06  15.04  15.58  15.07  15.05  14.98  14.93  15.10   90.77
 EC4  26.69  26.74  27.96  27.87  27.85  27.92  27.91  27.56  165.07
 EC5   7.51   7.63   8.13   8.26   8.29   8.29   8.31   8.06   48.11
 TEC 118.91 120.09 127.61 126.28 127.14 128.04 126.43 124.93  748.06
HPEC  .0308  .0311  .0320  .0291  .0298  .0297  .0300  .0304
 PHU 26.23% -2.24%-17.01%-13.10%-12.88%-13.32%-12.92%-21.17%
 COP  1.684  1.665  1.617  1.782  1.741  1.742  1.729  1.710
LMTD 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 U     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

Table H-89;

```
                  CLEARWATER MONITORING SYSTEM
             CALCULATIONS FOR WEEK STARTING 24 Jan 1986

 DAY      8      9     10     11     12     13     14    AVE    TOTAL   2WK-TOT
DATE 24 Jan 25 Jan 26 Jan 27 Jan 28 Jan 29 Jan 30 Jan
 HT1   -0.0    0.0   -0.0   -8.4     .6     .5  -10.6  -32.8-4.297E+2-4.321E+2
 HT2  343.5  353.1  346.7  283.9  212.6  144.2  171.1  263.6 5.190E+4 9.838E+4
 HT3    0.0    0.0    0.0   72.0  115.2   51.0   35.8   30.2 6.523E+3 6.524E+3
 HT4   94.6   86.5   83.6  156.4  168.4   93.3   82.6  111.7 2.079E+4 3.540E+4
 HT5  108.3   99.9   97.6   99.4   76.8   33.7   34.2  172.8 1.600E+4 3.148E+4
 EC1    .03   0.00    .08  71.17  71.58  68.54  71.17  66.84  282.58   283.11
 EC2  75.58  74.82  73.98  67.17  73.44  49.20  46.31  65.79  535.79   979.41
 EC3  15.35  15.38  15.25  14.07  12.91  11.06  11.85  13.69  110.79   201.56
 EC4  27.95  27.90  27.99  27.84  27.82  26.59  27.73  27.69  221.72   386.74
 EC5   8.35   8.39   8.37   7.83   7.79   7.42   7.73   7.98   64.20   112.31
 TEC 127.27 126.48 125.67 188.08 193.54 162.80 164.80 182.00 1215.07  1963.14
HPEC  .0333  .0360  .0369  .0179  .0182  .0229  .0234  .0258
 PHU-14.48%-15.42%-16.81% 36.45% 54.41% 63.87% 58.60%-54.68%
 COP  1.555  1.437  1.404  2.895  2.850  2.259  2.218  2.099
LMTD 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 U     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

Table H-90;

```
                    CLEARWATER MONITORING SYSTEM
              CALCULATIONS FOR WEEK STARTING 31 Jan 1986

 DAY      1       2       3       4       5       6       7     AVE     TOTAL
DATE  31 Jan   1 Feb   2 Feb   3 Feb   4 Feb   5 Feb   6 Feb
 HT1    -0.0    -0.0    -0.0     -.1    -0.0    -0.0    -0.0    -0.0-3.812E+0
 HT2   213.2   212.5   204.9    19.3   141.0   194.5   211.6   158.9 2.322E+4
 HT3     0.0     0.0     0.0    -0.0     0.0     0.0     0.0     0.0-8.817E-2
 HT4   146.0   146.1   145.5     8.9   105.9   127.5   123.8   105.3 1.603E+4
 HT5    86.5    90.4    88.8     6.2    66.7    76.3    73.7    64.7 9.830E+3
 EC1     .05     .01     .05     .16     .08     .01     .01     .05      .37
 EC2   65.33   66.54   71.00   11.01   61.34   70.35   70.42   59.43   345.57
 EC3   14.68   14.64   15.19    3.87   13.10   14.81   14.77   13.01    76.30
 EC4   26.62   26.85   27.97   27.63   27.57   27.63   27.61   27.41   164.27
 EC5    7.49    7.50    7.79    2.02    6.91    7.89    7.89    6.78    39.60
 TEC  114.17  115.53  122.01   44.70  108.99  120.70  120.71  106.69   626.11
HPEC   .0195   .0198   .0203   .0518   .0241   .0230   .0237   .0216
 PHU  40.73%  38.13%  38.93%  30.50%  37.03%  38.59%  40.48%  38.57%
 COP   2.663   2.617   2.547   1.000   2.147   2.254   2.185   2.177
LMTD  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 U      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

Table H-91;

```
                    CLEARWATER MONITORING SYSTEM
              CALCULATIONS FOR WEEK STARTING  7 Feb 1986

 DAY      8       9      10      11      12      13      14     AVE     TOTAL   2WK-TOT
DATE   7 Feb   8 Feb   9 Feb  10 Feb  11 Feb  12 Feb  13 Feb
 HT1     0.0     0.0    -0.0     0.0     0.0     0.0     0.0    -0.0-1.837E-1-3.996E+0
 HT2   210.7   202.0   189.3   189.6   210.6   194.2   210.6   201.1 3.885E+4 6.207E+4
 HT3     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 5.373E-2-3.443E-2
 HT4   123.3   120.2   117.8   117.2   116.3   118.5   111.6   118.0 2.277E+4 3.879E+4
 HT5   107.2   104.2   106.2   116.9   124.6   131.4   124.3   122.6 2.132E+4 3.115E+4
 EC1    0.00    0.00     .01    0.00    0.00    0.00    0.00    0.00      .03       .39
 EC2   70.07   71.01   71.83   72.16   73.51   73.85   72.69   72.16   575.54    921.11
 EC3   14.69   14.64   14.62   14.52   14.45   14.44   14.44   14.54   116.57    192.87
 EC4   27.79   27.80   27.79   27.72   27.63   27.49   27.49   27.67   221.33    385.60
 EC5    7.99    8.01    8.03    8.06    8.09    8.17    8.19    8.08    64.44    104.04
 TEC  120.54  121.45  122.29  122.46  123.68  123.95  122.81  122.46   977.90   1604.01
HPEC   .0237   .0246   .0254   .0257   .0263   .0260   .0271   .0253
 PHU  13.09%  13.32%   9.80%    .25% -7.15%-10.90%-11.34%  -3.96%
 COP   2.188   2.105   2.038   2.019   1.966   1.995   1.909   2.032
LMTD  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 U      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

Table H-92;

```
                    CLEARWATER MONITORING SYSTEM
              CALCULATIONS FOR WEEK STARTING 14 Feb 1986

 DAY      1       2       3       4       5       6       7     AVE     TOTAL
DATE  14 Feb  15 Feb  16 Feb  17 Feb  18 Feb  19 Feb  20 Feb
 HT1    0.0     0.0    -0.0     0.0     0.0     0.0    -0.0    -0.0-1.150E-1
 HT2  219.3   237.9   242.2   256.9   253.9   268.9   274.4   250.5 3.502E+4
 HT3    0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 7.067E-3
 HT4   62.4    58.0    56.6    55.6    96.5    97.5    95.9    73.8 1.012E+4
 HT5   68.3    25.4    28.8    29.0   110.0   110.5   109.1   108.0 8.876E+3
 EC1   0.00    0.00     .01    0.00    0.00    0.00     .02    0.00      .01
 EC2  52.05   46.86   50.54   50.41   70.96   73.28   73.73   59.69   344.10
 EC3  14.06   13.50   14.75   14.71   14.72   14.71   14.70   14.45    86.45
 EC4  27.48   25.20   27.47   47.11   53.25   53.31   53.22   41.00   233.81
 EC5   7.57    7.14    7.79    7.82    8.31    8.40    8.46    7.93    47.04
 TEC 101.16   92.72  100.56  120.05  147.23  149.70  150.13  123.08   711.41
HPEC  .0347   .0367   .0372   .0378   .0306   .0313   .0320   .0340
 PHU -9.38%  56.28%  49.20%  47.82%-14.00%-13.35%-13.79%-46.32%
 COP  1.491   1.412   1.392   1.372   1.691   1.653   1.617   1.519
LMTD 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 U     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

Table H-93;

```
                    CLEARWATER MONITORING SYSTEM
              CALCULATIONS FOR WEEK STARTING 21 Feb 1986

 DAY      8       9      10      11      12      13      14     AVE     TOTAL   2WK-TOT
DATE  21 Feb  22 Feb  23 Feb  24 Feb  25 Feb  26 Feb  27 Feb
 HT1    0.0     -.1    -0.0     -.1     0.0     -.1     -.1     -.1-9.066E+0-9.181E+0
 HT2  251.1   176.8   161.2   159.6   162.5   110.0   134.6   164.3 3.432E+4 6.935E+4
 HT3    0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 3.915E+0 3.922E+0
 HT4   90.6   150.1   149.4   143.0   163.1   174.5   175.6   149.5 2.742E+4 3.754E+4
 HT5  104.6   160.0   159.7   155.1   171.2   186.1   187.1   161.6 2.959E+4 3.847E+4
 EC1   0.00     .33     .14     .16    0.00     .15     .26     .15     1.06      1.07
 EC2  68.23   69.98   70.15   67.63   82.73   90.97   92.27   77.43   615.71    959.81
 EC3  14.65   14.40   14.38   14.33   14.29   14.29   14.27   14.37   115.32    201.77
 EC4  52.99   52.84   52.79   52.38   52.16   51.42   51.17   52.25   418.97    652.79
 EC5   8.37    8.29    8.31    8.30    8.34    8.42    8.44    8.35    66.93    113.96
 TEC 144.23  145.86  145.78  142.80  157.53  165.25  166.41  152.55  1217.98   1929.40
HPEC  .0314   .0194   .0196   .0197   .0211   .0217   .0219   .0225
 PHU-15.42%  -6.56%  -6.91%  -8.40%  -4.94%  -6.63%  -6.59%  -8.11%
 COP  1.652   2.667   2.648   2.629   2.452   2.385   2.365   2.400
LMTD 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 U     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

Table H-94;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 28 Feb 1986

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	28 Feb	1 Mar	2 Mar	3 Mar	4 Mar	5 Mar	6 Mar		
HT1	-.3	-0.0	-.1	0.0	0.0	0.0	-0.0	-0.0	-8.846E+0
HT2	143.0	159.3	172.6	228.3	271.1	288.7	228.5	210.0	2.889E+4
HT3	.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.950E+0
HT4	174.3	174.9	168.5	144.0	132.6	97.6	104.4	142.3	2.088E+4
HT5	185.1	185.5	181.8	158.0	152.2	66.5	107.0	161.6	2.188E+4
EC1	.67	.09	.18	0.00	0.00	0.00	.19	.17	.94
EC2	91.50	92.58	93.91	96.55	88.29	60.29	70.35	84.78	523.13
EC3	14.25	14.23	14.30	14.54	13.95	12.15	13.78	13.89	83.42
EC4	49.72	49.72	49.65	49.04	46.15	38.55	44.77	46.80	282.82
EC5	8.46	8.44	8.42	8.24	7.97	6.62	7.80	7.99	48.14
TEC	164.60	165.07	166.46	168.37	156.36	117.60	136.88	153.63	938.45
HPEC	.0219	.0221	.0232	.0279	.0289	.0309	.0281	.0250	
PHU	-6.23%	-6.05%	-7.90%	-9.70%	-14.76%	31.90%	-2.54%	-13.57%	
COP	2.368	2.349	2.231	1.854	1.790	1.677	1.844	2.024	
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table H-95;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 7 Mar 1986

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	7 Mar	8 Mar	9 Mar	10 Mar	11 Mar	12 Mar	13 Mar			
HT1	-.2	-0.0	0.0	-0.0	-0.0	-0.0	-32.7	-16.4	-7.910E+2	-7.999E+2
HT2	28.9	205.1	234.6	230.7	223.7	240.3	232.7	189.0	3.688E+4	6.577E+4
HT3	-0.0	0.0	0.0	0.0	0.0	0.0	14.9	2.1	3.568E+2	3.607E+2
HT4	102.2	98.2	96.1	51.9	48.3	49.6	48.3	92.7	1.381E+4	3.469E+4
HT5	1.7	104.7	104.0	36.5	24.6	28.4	68.8	67.9	1.109E+4	3.297E+4
EC1	40.23	2.42	0.00	4.88	6.37	12.69	78.33	72.59	145.11	146.05
EC2	22.71	72.19	71.13	30.17	51.55	51.95	48.27	49.71	418.33	941.45
EC3	4.32	14.47	14.41	8.40	14.45	14.42	12.73	11.89	96.99	180.41
EC4	43.62	46.51	26.68	15.61	25.16	42.80	47.12	35.36	292.26	575.08
EC5	2.44	8.19	8.23	4.94	7.89	7.97	7.77	6.78	55.23	103.36
TEC	113.32	143.78	120.46	64.01	105.41	129.83	194.22	176.32	1007.90	1946.36
HPEC	.0097	.0306	.0309	.0387	.0444	.0437	.0416	.0303		
PHU	98.35%	-6.59%	-8.28%	29.66%	49.10%	42.72%	-42.28%	26.74%		
COP	5.358	1.691	1.679	1.337	1.166	1.186	1.245	2.181		
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Table H-96;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 14 Mar 1985

DAY	1	2	3	4	5	6	7	AVE	TOTAL
DATE	14 Mar	15 Mar	16 Mar	17 Mar	18 Mar	19 Mar	20 Mar		
HT1	0.0	-0.0	-0.0	0.0	0.0	-0.0	0.0	-0.0	-5.879E-2
HT2	174.6	161.2	158.8	157.1	143.5	120.9	89.9	143.3	2.124E+4
HT3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.121E-1
HT4	57.6	57.2	57.6	57.9	58.3	87.9	127.2	71.9	8.717E+3
HT5	37.2	39.4	34.5	45.5	38.2	39.1	45.0	39.9	5.422E+3
EC1	0.00	29.75	25.94	80.93	77.50	78.90	0.00	20.80	293.02
EC2	49.37	45.74	47.85	50.31	48.53	58.59	72.10	53.21	300.39
EC3	13.05	11.93	12.42	12.85	12.26	12.29	12.82	12.52	74.79
EC4	47.07	43.23	45.18	46.12	26.19	24.61	24.01	36.63	232.40
EC5	7.71	7.06	7.39	7.91	7.60	7.52	7.80	7.57	45.20
TEC	117.20	137.72	138.78	198.12	172.08	181.91	116.73	130.73	945.81
HPEC	.0357	.0364	.0361	.0362	.0362	.0290	.0236	.0345	
PHU	35.47%	31.14%	40.08%	21.50%	34.42%	55.48%	64.59%	44.49%	
COP	1.452	1.424	1.434	1.431	1.431	1.787	2.193	1.630	
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table H-97;

CLEARWATER MONITORING SYSTEM
CALCULATIONS FOR WEEK STARTING 21 Mar 1985

DAY	8	9	10	11	12	13	14	AVE	TOTAL	2WK-TOT
DATE	21 Mar	22 Mar	23 Mar	24 Mar	25 Mar	26 Mar	27 Mar			
HT1	0.0	-0.0	-0.0	0.0	0.0	-0.0	1.5	-4.2	3.503E+1	3.497E+1
HT2	100.7	97.6	107.8	96.9	96.9	79.1	236.8	116.1	2.174E+4	4.298E+4
HT3	0.0	0.0	0.0	0.0	0.0	0.0	109.1	18.3	2.620E+3	2.620E+3
HT4	124.4	123.4	123.7	124.0	122.5	126.9	172.8	131.0	2.508E+4	3.379E+4
HT5	48.5	45.6	52.3	47.0	54.6	48.7	69.7	52.5	9.876E+3	1.530E+4
EC1	0.00	.06	.17	0.00	0.00	83.23	82.82	66.70	166.27	459.29
EC2	70.30	71.11	70.88	71.11	70.86	71.55	86.42	73.17	584.32	884.71
EC3	12.86	12.85	12.85	12.82	12.80	12.80	13.11	12.87	102.91	177.70
EC4	23.71	22.66	22.72	22.03	23.25	23.73	25.32	23.34	187.42	419.82
EC5	8.02	8.09	8.08	8.06	8.08	7.84	7.91	8.01	63.89	109.09
TEC	114.88	114.76	114.70	114.02	114.99	199.15	215.59	184.10	1104.81	2050.62
HPEC	.0236	.0240	.0239	.0239	.0241	.0235	.0208	.0233		
PHU	61.00%	63.03%	57.71%	62.09%	55.42%	61.64%	59.65%	59.87%		
COP	2.199	2.158	2.169	2.168	2.150	2.204	2.486	2.225		
LMTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

APPENDIX 'I' - FACILITY DATA

TABLE I-1 - Weekly Product Inventory - May 3, 1985 To December 6, 1985.

TABLE I-2 - Weekly Product Inventory of D.L.P.'s - May 3, 1985 to December 6, 1985.

TABLE I-3 - Weekly Product Inventory of Tankhouse and Reservoir - May 3, 1985 to December 5, 1985.

TABLE I-4 - Electrical Energy Usage and Costs for 12 Months Period Ending November 2, 1985.

TABLE I-1

WEEKLY LOBSTER INVENTORY, SUMMER, 1985 01/01/80 PAGE 1

1985 WEEK ENDING:	LOBSTER INVENTORY (LBS.) DLP1	DLP2	DLP3	TOTAL DLP'S	WEEKLY AVERAGE IN TANK HOUSE	LAB	HEATED WEEKLY AVG. TEMP. IN LAB T(C)	AMBIENT WEEKLY AVG. TEMP. IN LAB T(C)
03-May	0	0	15,040	15,040	6,034	0		
10-May	0	0	54,380	54,380	6,337	0		
17-May	0	9,305	108,758	118,063	8,336	0		
24-May	15,928	34,620	207,700	258,248	61,809	0		
31-May	101,289	80,794	265,548	447,631	95,788	0		
07-Jun	191,582	114,888	291,103	597,573	70,986	0		
14-Jun	231,723	122,411	300,603	654,737	51,111	0		
21-Jun	266,291	154,153	302,349	722,793	58,936	0		
28-Jun	274,548	174,431	302,301	751,280	70,949	0		
05-Jul	277,662	174,429	316,548	768,639	56,670	0		
12-Jul	279,844	171,428	288,690	739,962	55,146	0		
19-Jul	279,844	159,621	290,596	730,061	36,136	679	15.8	11.3
26-Jul	271,105	134,800	264,818	670,723	11,013	883	15.0	10.1
02-Aug	248,394	106,754	241,968	597,116	15,733	847	17.0	10.2
09-Aug	214,070	86,992	224,009	525,071	9,588	917	18.3	10.7
16-Aug	191,516	77,807	212,012	481,335	10,200	917	18.3	11.5
23-Aug	183,143	106,135	198,346	487,624	14,536	835	18.5	10.7
30-Aug	164,947	84,759	175,332	425,038	19,087	887	16.5	10.6
06-Sep	148,239	75,559	160,507	384,305	2,616	885	17.5	11.9
13-Sep	130,049	69,673	168,169	367,891	1,785	865	20.5	14.7
20-Sep	125,795	66,918	134,084	326,797	3,977	858	21.0	15.1
27-Sep	122,437	73,316	115,588	311,341	9,576	855	20.2	15.2
04-Oct	109,456	73,282	100,753	283,491	25,409	1019	18.8	14.9
11-Oct	101,157	64,571	83,467	249,195	20,385	879	17.5	13.1
18-Oct	73,154	25,970	67,285	166,409	8,304	844	17.5	11.2
25-Oct	59,461	7,358	75,273	142,092	1,755	844	10.5	10.4
01-Nov	32,031	3,839	80,380	116,250	0	830	8.8	8.8
08-Nov	16,937	0	88,169	105,106	5,125	810	8.5	8.5
15-Nov	14,903	0	108,670	123,573	4,589	804	7.0	7.0
22-Nov	0		105,653	105,653	3,410	804	7.5	7.5
29-Nov	0		102,915	102,915	25,100	780	7.5	7.5
06-Dec	0		91,430	91,430	41,347	780	6.0	6.0

FIGURE 1-2 - INVENTORY OF LOBSTERS HELD IN DLP'S

CLARK'S HARBOUR, SUMMER, 1985 SEASON.

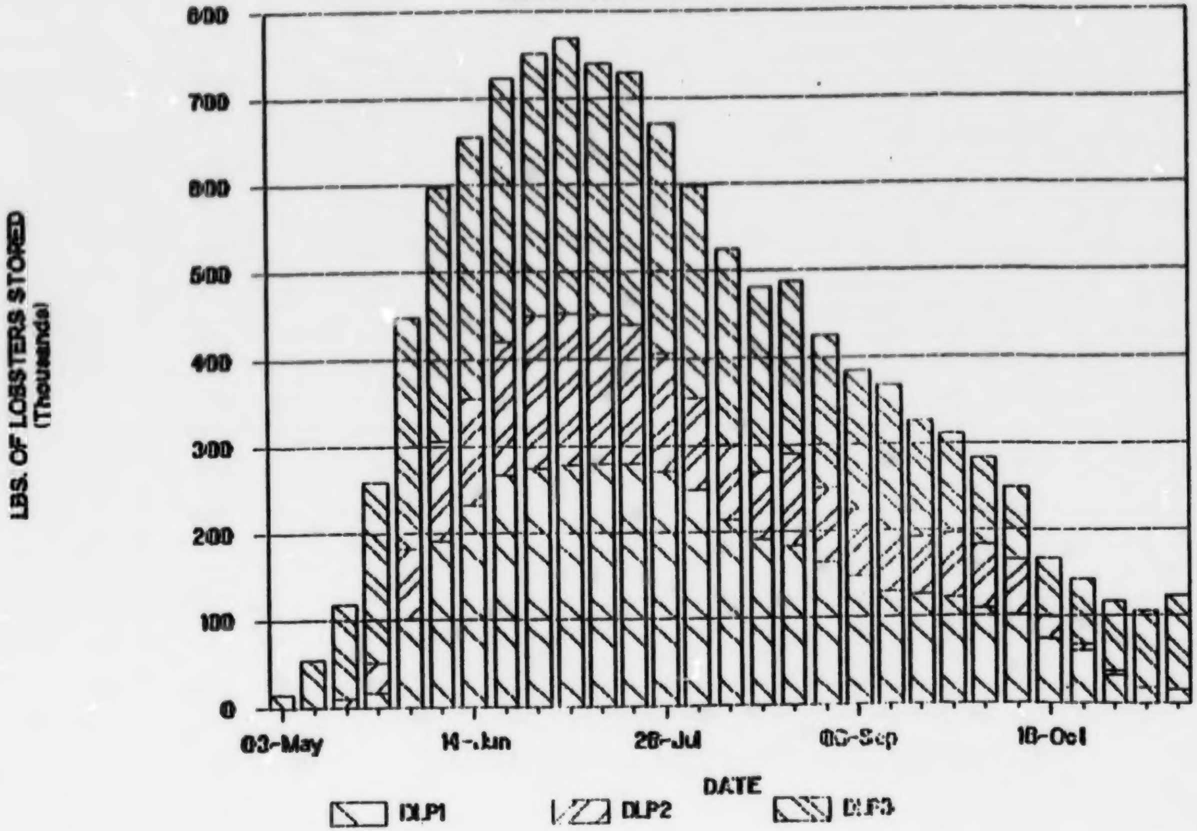


FIGURE I-3 - INVENTORY OF LOBSTERS HELD IN DLP'S

CLARK'S HARBOUR, SUMMER, 1985 SEASON

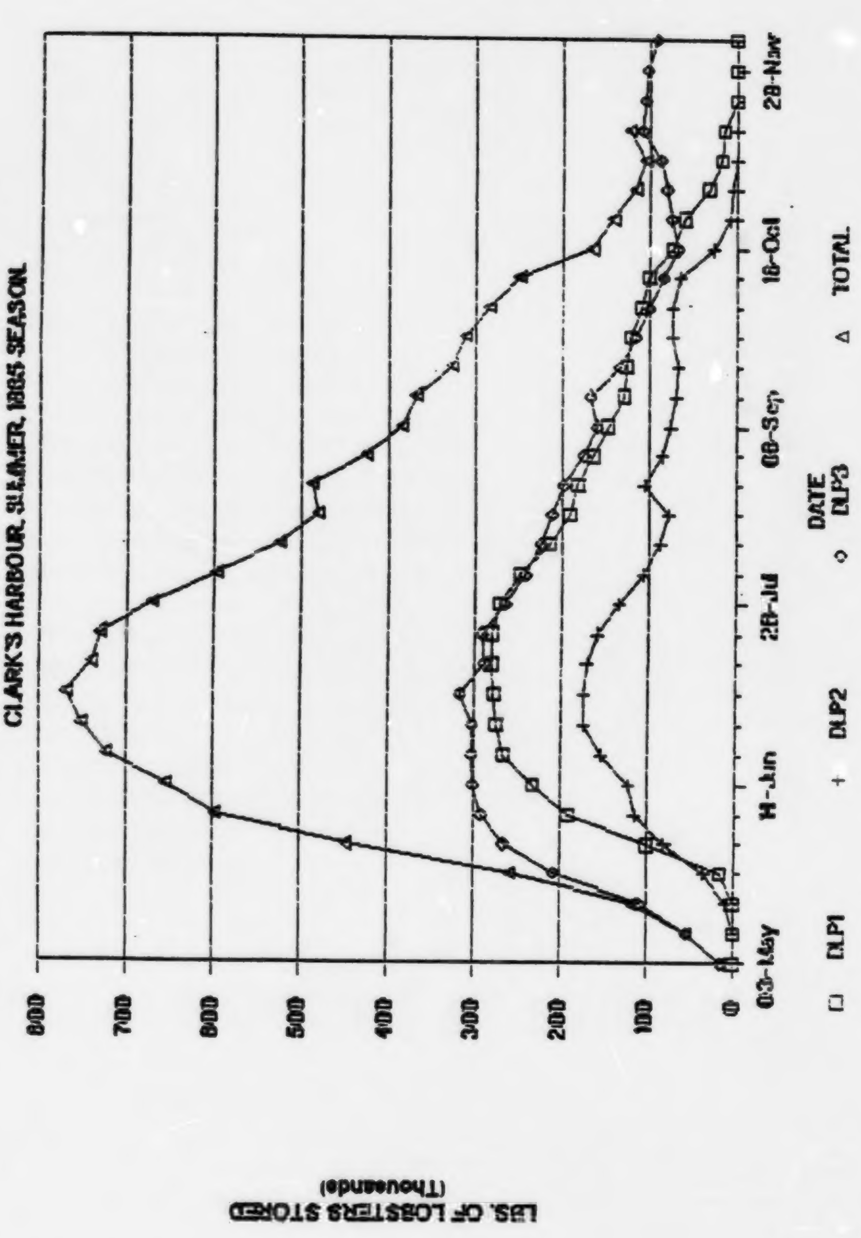


Table I-4 - Electrical Energy Useage and Costs for 12 Month Period Ending November 29,1986

PERIOD (1)		DEMAND	USAGE	% LOAD	AVERAGE USAGE		ENERGY CHARGES		
ENDING (2)	DAYS (2)	(2) KVA	(2) KWH	FACTOR	KWH/D	KWH/H	FOR PERIOD	(2) AV. $/D	AV. $/KWH
Jan.2/85	28	326.4	178,754	85.8	6,384.1	266.0	8,428.86	301.03	0.0472
Jan 29/85	31	288.0	183,638	90.2	5,923.8	246.8	8,371.20	270.04	0.0456
Feb.26/85	28	268.8	148,474	86.5	5,302.6	220.9	6,992.13	249.72	0.0471
Mar.28/85	32	172.8	106,471	84.4	3,327.2	138.6	4,901.45	153.17	0.0460
Apr.29/85	32	230.4	67,399	40.1	2,106.2	87.8	3,848.12	120.25	0.0571
May30/85	31	441.6	188,522	60.4	6,081.4	253.4	9,478.68	305.76	0.0503
Jun.27/85	28	480.0	239,316	78.1	8,547.0	356.1	11535.46	411.98	0.0482
Jul.30/85	33	499.2	386,813	103.0	11,721.6	488.4	16947.81	513.57	0.0438
Aug.29/85	30	480.0	304,762	92.8	10,158.7	423.3	13885.27	462.84	0.0456
Sept.27/85	31	480.0	325,274	95.9	10,492.7	437.2	14621.75	471.67	0.0450
Oct.31/85	31	480.0	249,084	73.4	8,035.0	334.8	11886.17	383.42	0.0477
Nov.28/85	29	288.0	156,288	82.1	5,389.20	244.6	7,389.20	254.80	0.0473
TOTALS	364	------	2,534,795	-----	-------	----	118,286.10	------	-----
AVERAGES	30.33	369.6	211,233	82.6	6,964.5	290.19	9,857.18	325.00	0.0467

(1) ASSUMED AVERAGE P.F. OF 0.95

SOURCE: NOVA SCOTIA POWER CORPORATION

APPENDIX 'J'

J-1 - Biological Reports on Holding of Live Lobster in Cold Seawater Environment.

J-1 - Temperature of Ambient and Heated Seawater in Warm Seawater Laboratory Experiments.

CLEARWATER LOBSTERS LTD., CLARK'S HARBOUR DIVISION

J.1 - Development of Technologies for Extended Duration, Land-Based, Live Lobster (*Homarus*) Storage, and for Lobster Resource Value Enhancement, Through Short-Term Culture: Progress Report and Plan for Continuing Research.

by

Martina Kaneps, Senior Biologist
Clearwater Lobsters
P.O. Box 209, Clark's Harbour, N.S. B0W 1P0
(902)745-3400

November, 1985

INTRODUCTION

The research and commercial development efforts of Clearwater Lobsters are oriented toward two objectives.

The first objective (Phase I) is to develop the technology, systems, and operational protocol to maintain commercial quantities of market quality lobsters throughout the year. A glut of lobsters occurs during the spring and fall, when most of the Canadian lobster fishing districts are open and the United States fishery is landing high quality lobsters. A shortage of live lobsters exists during the balance of the year, when closed Canadian seasons, adverse, winter weather conditions, or a summer predominance of recently molted lobsters, with low meat yield, poor quality meat, and reduced survival, occur. The market value of lobsters fluctuates with the supply cycle. In attempts to level out the seasonal supply cycle and to speculate on the lobster market, the lobster industry has tried various systems for holding live lobsters beyond periods of peak supply. Traditional systems are only capable of supporting live lobsters for short holding durations, and result in substantial waste, through mortalities and quality reduction, of the limited lobster resource. Traditional holding systems are vulnerable to environmental fluctuations. Aggressive interactions among communally held lobsters result in losses from cannibalism, wounding, stress, and injury facilitated disease dissemination. Storage of live lobsters throughout the summer has been precluded, primarily due to molting, which occurs from July through September. Excessive molting related mortalities occur, and meat yield and quality, and capability to survive stress, handling, and shipping are reduced. High oxygen requirements of lobsters held in warm seawater, coupled with the low capacity of warm seawater to dissolve oxygen, can result in dissolved oxygen depletion in holding systems. Excretion rates of ammonia, which is particularly toxic to lobsters in the unionized form, are elevated among lobsters held in warm water, and the proportion of the total ammonia which is in the unionized form increases with a rise in temperature. Warm seawater held lobsters have increased feeding requirements, and suffer from physiological deterioration from starvation over short periods.

Individually segregated holding compartments eliminate aggressive interactions among lobsters, effectively eliminating cannibalism, wounding, and disease transmission. Cold holding temperatures can inhibit molting, with its associated losses, through the summer. Water quality problems, disease dissemination, and feeding requirements are also reduced by cold holding temperatures. Efforts at Clearwater have concentrated on the development of a unique, land-based, live lobster storage facility, incorporating a chilled, semi-recirculated, seawater supply, and high density, individually segregated, holding compartments, for extended duration, live lobster storage.

The objective of Phase II is to add value to the existing lobster resource by increasing weight and upgrading to higher priced size classifications, through short term grow-out, over one molt cycle (molting, recalcification, and meat yield recovery).

The purpose of this report is to briefly summarize the advances which have been achieved towards extended duration live storage of lobsters and short-term lobster culture; to identify areas, critical to full, commercial implementation of the developing technology, in which biological or technical data is still lacking; and to propose a research plan to attempt to resolve the remaining questions.

PHASE I.

Significant progress has been achieved in the following areas:

1. The oxygen consumption rate of captive lobsters held at 4°C was determined, and the passive reaeration rate of seawater within the holding system was evaluated, in order to define the optimum seawater recirculation flow rate.

2. The ammonia excretion rate of lobsters held at 4°C was determined, and the activity of nitrifying bacteria within the system was quantified, in order to define the optimum, influent, seawater flow rate.

3. A database of the molt stage frequency distributions of lobsters from various districts at different times during the year is being maintained in order to select appropriate lobsters for cold seawater, molt inhibition, during the summer. A pattern of molt sequences is emerging from this data, and the incidence of molting in the DLP has been significantly reduced below natural molting levels.

4. Markedly reduced survival occurred during shipment of lobsters, which had experienced only low levels of mortality within the holding system, following about 140 to 150 days of unfed holding at .5°C. Significant progress has been made in identifying the cause of this problem. Starvation results in the depletion of the blood protein levels of lobsters. The major constituent of the total blood protein of lobsters is hemocyanin, a respiratory pigment which aids in the transport of oxygen from the gills to the body tissues during exposure to low environmental oxygen supplies and provides a reserve supply of oxygen above that which can be carried in solution in the blood plasma. Reduced hemocyanin levels reduce the capacity of starved lobsters to survive in air. Experiments have been undertaken to determine (1) the level of total, blood plasma protein corresponding to a hemocyanin concentration below which diminished survival of lobsters in air occurs, (2) the rates at which lobster, plasma protein levels decline during unfed holding at various temperatures, and (3) the initial plasma

protein levels among newly captured lobsters from various districts at different times during the year. Feeding of lobsters following prolonged, unfed holding in chilled seawater, results in a rapid recovery of plasma protein levels, and a corresponding reduction in mortalities following exposure in air.

5. An experiment was carried out to evaluate the efficacy of a vaccine preparation in protecting lobsters from gaffkemia disease of lobsters. The study demonstrated the harmlessness of the preparation to the lobsters, as well as refined the procedure for large scale medication of lobsters.

Further effort is required in the following areas to fully implement the advantages of extended duration lobster holding:

1. Molting rates in the DLP are still too high during the summer, primarily due to the inability of the system to maintain temperatures consistently below 5°C throughout the summer. After modifications are made to the heat pump/heat exchanger installation to maintain lower holding temperatures, the molt inhibition procedure can be refined.

2. The effect of holding temperatures between 5 and 1°C on mitigating the detrimental consequences of prolonged starvation, particularly the rate of hemocyanin depletion, should be evaluated.

3. Studies to monitor the physiological effects of prolonged holding durations, at various temperatures, and subsequent exposure in air should be continued, incorporating new assay procedures for exoskeletal and blood calcium content, blood hemocyanin and lactate concentrations, blood pH, and tissue A.T.P. levels. The potential for using artificial oxygen carrying flourocarbon compounds to assess the relative contribution of hemocyanin depletion on reduced air survival, following prolonged holding durations, should be evaluated.

4. Various feed preparations should be tested to compare the rates of plasma protein recovery produced when fed to previously starved lobsters. Improved equipment will be required for formulating various feed preparations.

5. Various feeding strategies, including (1) feeding lobsters prior to extended duration holding, in order to raise plasma protein levels to a uniformly high, initial concentration, (2) feeding impounded lobsters as soon as the blood protein levels begin to approach the critical level for decreased air survival, and (3) feeding previously impounded lobsters, until they have recovered normal plasma protein concentrations, prior to shipment, should be evaluated as methods for overcoming nutritional problems encountered during long-term holding.

6. Testing of vaccine preparations, as well as antibiotics and disinfectants, to protect lobsters from infection by disease causing organisms, and to reduce the levels of disease causing organisms in the holding system, should be continued.

7. Procedures should be improved for screening incoming lobsters to minimize the introduction of injured, weak, excessively stressed, or especially, diseased lobsters into the holding facility.

8. To facilitate the recommended studies, the wet laboratory must be modified to be able to maintain a wider range of holding temperatures throughout the year, to allow for easier access to the holding trays, and to allow for feeding and inspection of the lobsters without the necessity of draining the trays.

PHASE II.

The following progress has been acheived toward lobster resource, value enhancement through short-term culture:

1. A study is in progress to evaluate the effect of temperature (constant 18°C vs. Clark's Harbour, ambient, summer seawater temperatures) and holding compartment size on the time to molt, molting incidence, mortality rate, weight gain, rate of recalcification and meat yield recovery, and food conversion efficiency of incipient molt, male canner lobsters.

2. An experiment has been initiated to evaluate plasma protein recovery with feeding, time to molt, molt frequency, weight gain, rate of recalcification and meat yield recovery, mortality rate, and food conversion efficiency of male canner lobsters which were previously inhibited from molting by holding for for 4 months, without feeding, at 5 °C.

3. The ammonia excretion rates of lobsters held at various temperatures were determined in order to calculate the required influent seawater flow rate for warm water, molt promotion of lobsters, and the degree of water treatment required for various degrees of water reuse.

Areas in which further effort is required in order to assess the potential of Phase II are:

1. Repeated clogging, by detritus, of the plate heat exchangers in the wet laboratory has prevented the consistent maintenance of temperatures above the ambient seawater temperature. The initial molting study has resulted in a high mortality rate (18%), a wide variation in the time to molting, and a relatively low molting incidence (65%). Since the holding trays must be drained to feed and inspect the lobsters, the lobsters have only been fed every other day. As lobsters are

very slow feeders, this is a very inefficient process. The stress and disturbance of being out of water for several hours every other day has undoubtedly contributed to mortalities, reduced feeding, and reduced the molting incidence among the lobsters. Modifications should be made to the wet lab to facilitate access to the holding trays, to allow for feeding and inspection without the necessity of draining the trays, and to provide for a better range of temperature control.

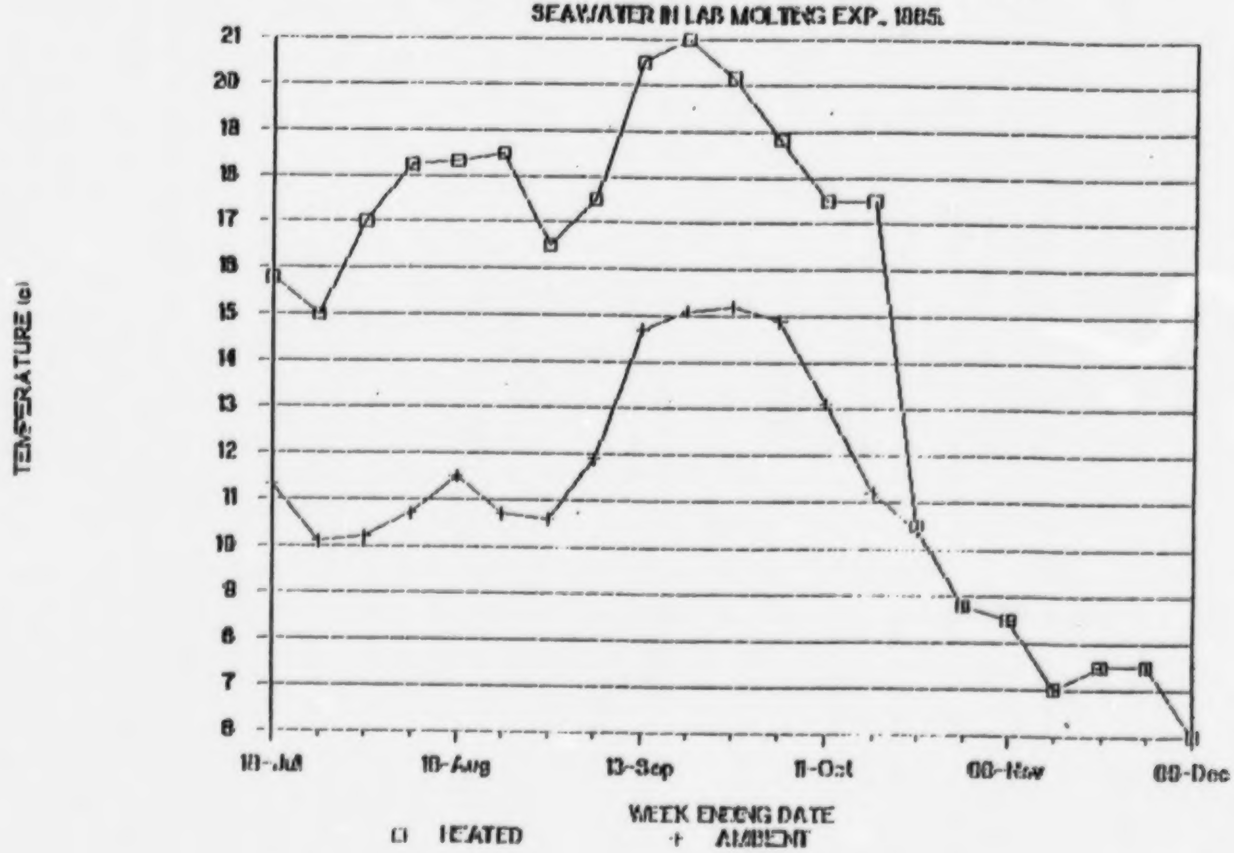
2. Efforts should be directed toward developing an automated feeding mechanism for feeding the lobsters, which can be adapted for larger scale feeding requirements.

3. Various feed preparations should be evaluated for the ability to produce full meat yield recovery over reasonable time periods.

4. Methods for synchronizing the molting of incipient molt lobsters, by temperature and photoperiod manipulations, should be investigated.

5. Nitrification efficiencies of various biological filtration media, under various conditions, should be evaluated to aid in the design of a water treatment system for a full commercial scale, molt promotion facility.

FIGURE J.1 - TEMPERATURE OF AMBIENT AND HEATED



APPENDIX 'K' - Recommended Modifications for Warm/Cold Seawater Experimental Laboratory

CLEARWATER LOBSTERS LTD., CLARK'S HARBOUR DIVISION

Required Modifications to the Wet Laboratory Facility, to Facilitate Proposed Research.

Research and commercial development efforts of Clearwater have been directed toward two objectives. The first objective, Phase I, is to develop the capability to store and provide the market with good quality (i.e., hard shelled, fully meated and capable of withstanding subsequent shipping and handling) lobsters throughout the year. The second objective, Phase II, is to increase the value of the existing lobster resource through weight increase and market classification upgrade by culturing lobsters through one molt cycle. To facilitate investigations aimed at resolving obstacles to full commercial implementation of these two objectives, a wet laboratory, lobster holding facility, was incorporated. The limitations of this facility for providing relevant data soon became apparent. Access to the lobster holding trays is difficult and potentially dangerous. The requirement for draining the trays in order to feed or inspect the lobsters causes disturbance and stress to the lobsters, reducing feeding, altering metabolic functions, reducing molting rates, and increasing mortalities. The dependence on ambient seawater cooling, and heat pump generated waste heat for holding seawater temperature control, severely limit the temperatures which can be maintained at different times of the year.

The following modifications should be made to the wet lab facility, to facilitate proposed investigations:

1. Enhanced access to the lobster storage trays:

   The present system for servicing the storage trays uses a series of wooden planks, which require several, difficult, vertical adjustments to service all of the trays. This is a difficult and dangerous system. A system providing easier access, more rapid height adjustment, and a stable working platform should be provided.

2. Capability to extract and service the trays while full of water.

   The present system requires that the holding trays be drained, before they can be extracted from the holding racks for servicing. The stored lobsters are repeatedly subjected to the stress of air exposure, for several hours during each servicing, over each investigation period. The results of the investigations are compromised by increased mortality, decreased feeding, and reduced molting rates. The system should be modified to allow the holding trays to be extracted for feeding and observation of the lobsters, without seawater flow interruptions. This will result in a large quantity of water draining onto the floor. A curb should be built to keep this water from flooding the entire floor area.

3. Increased holding temperature range:

Since the current, seawater temperature, control system depends on the heat pump. waste heat production for heating, and ambient seawater mixing for cooling, temperatures below ambient cannot be obtained; and during periods when the heat pump can not be operated, temperatures above ambient can not be maintained. A portion of the cooling capacity of the heat pump should be made available to the laboratory, and an alternate method for heating should be provided for periods during which the heat pump can not be operated. The capacity to obtain the following holding conditions should be provided:

- Each rack should have the capability of being operated at an independent holding temperature.

- Cooling from the heat pump system should provide temperatures down to the cold seawater holding system water temperature. This is currently 4 to 5°C, but should be reduced to 1.5 to 2° in the future.

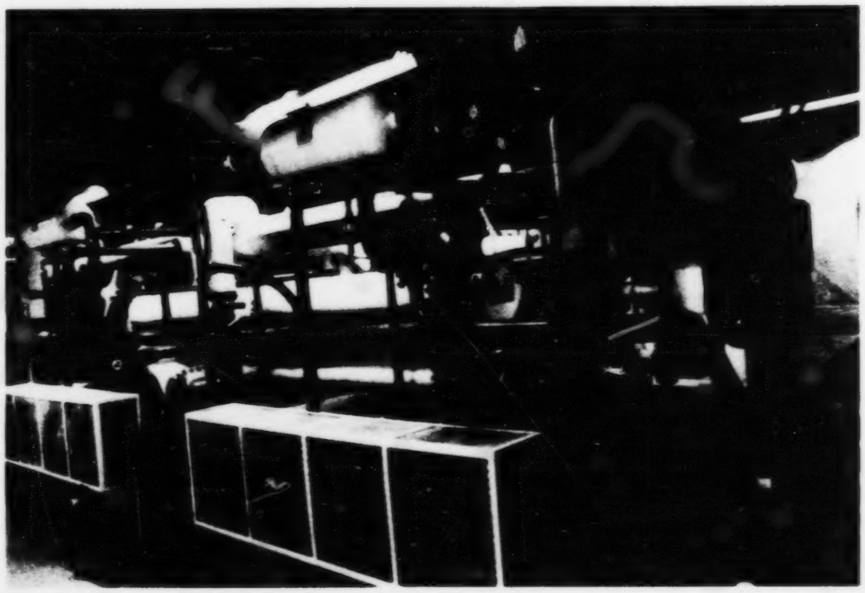
- Maintenance of constant temperatures ranging from ambient to at least 15°C should be achievable, even during periods when the heat pump is not being operated.

- The capacity to operate the system at various rates of recycling should be maintained, although this can be independent of the temperature control systems. During investigations using this potential, the ability to operate at two independent temperatures can be sacrificed.

APPENDIX 'L'

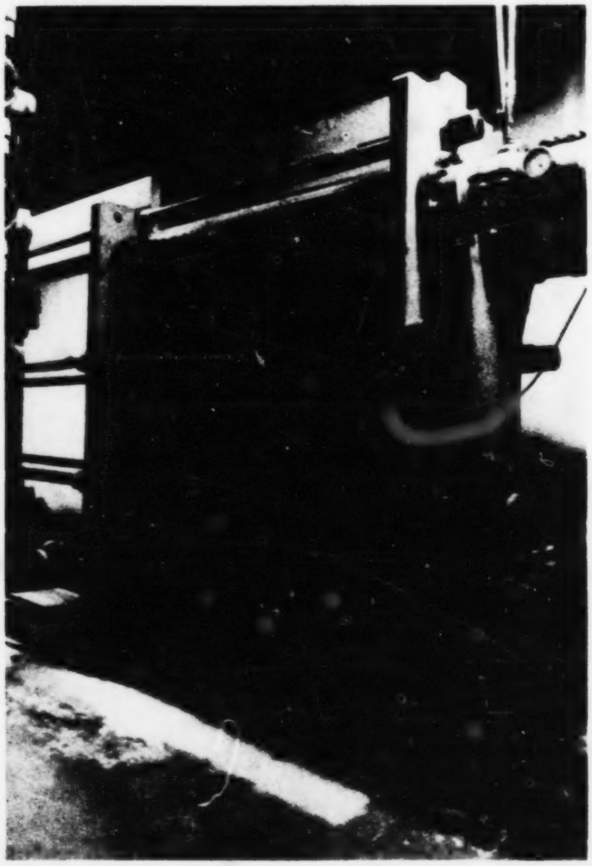
Photographs of Facility

CLEARWATER LOBSTERS LIMITED
CLARK'S HARBOUR

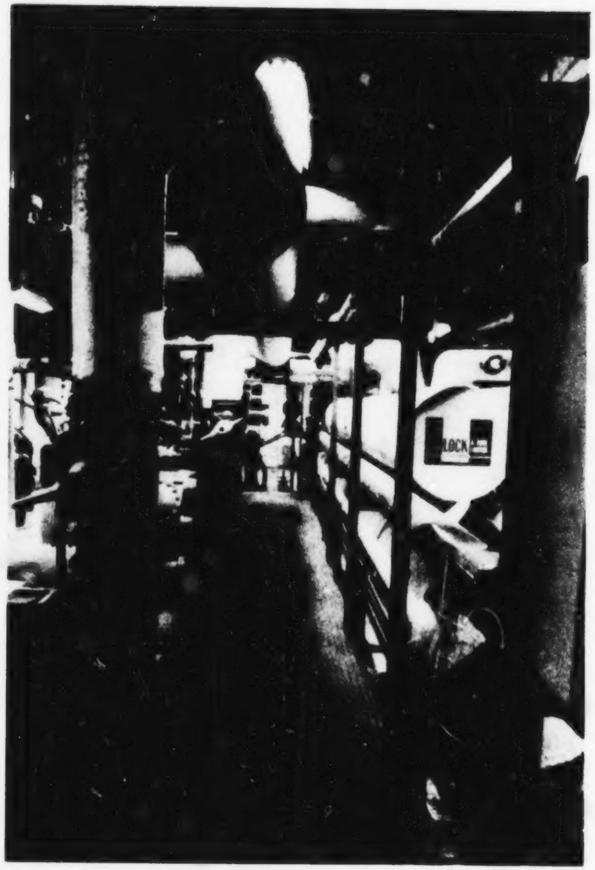


HEAT PUMP

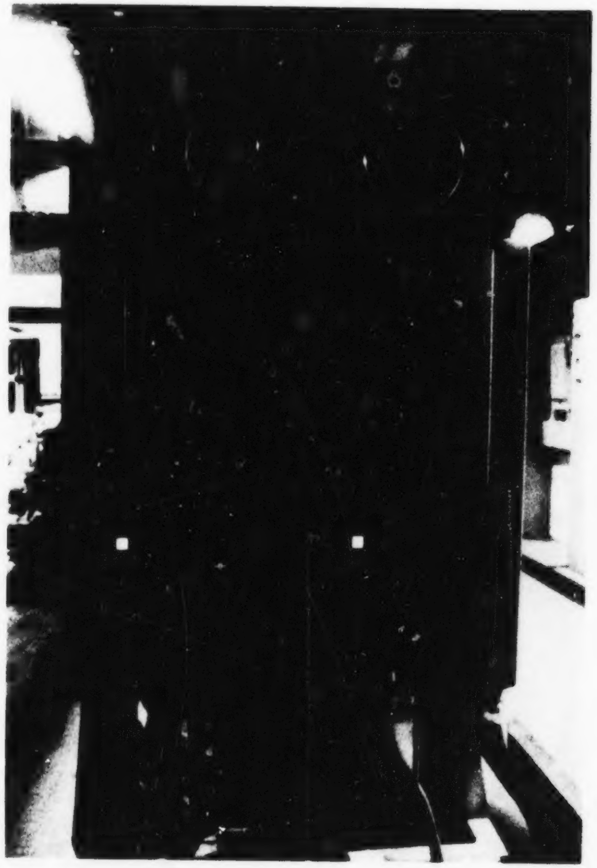
COLD SEAWATER PLATE HEAT EXCHANGER



COLD SEAWATER PLATE HEAT EXCHANGER



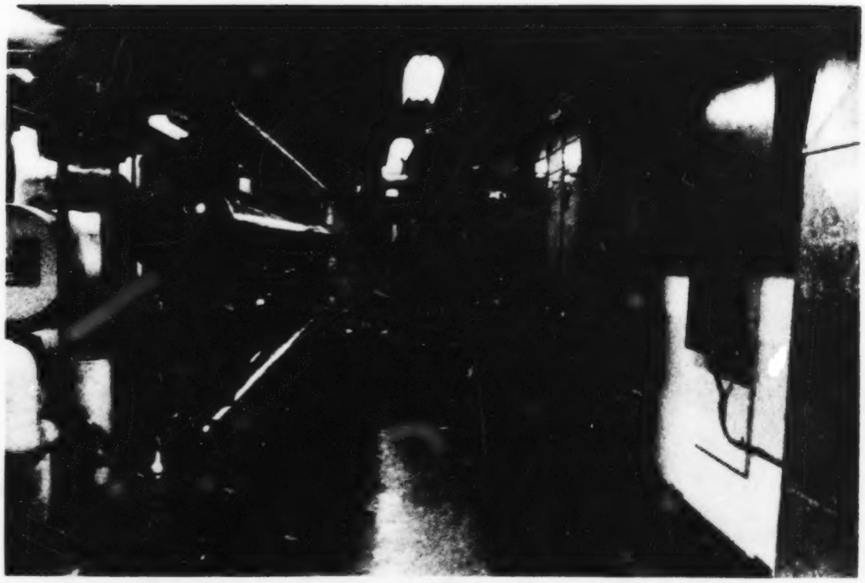
HEAT PUMP
COMPRESSORS AND
EVAPORATOR



HEAT PUMP
CONTROL PANEL

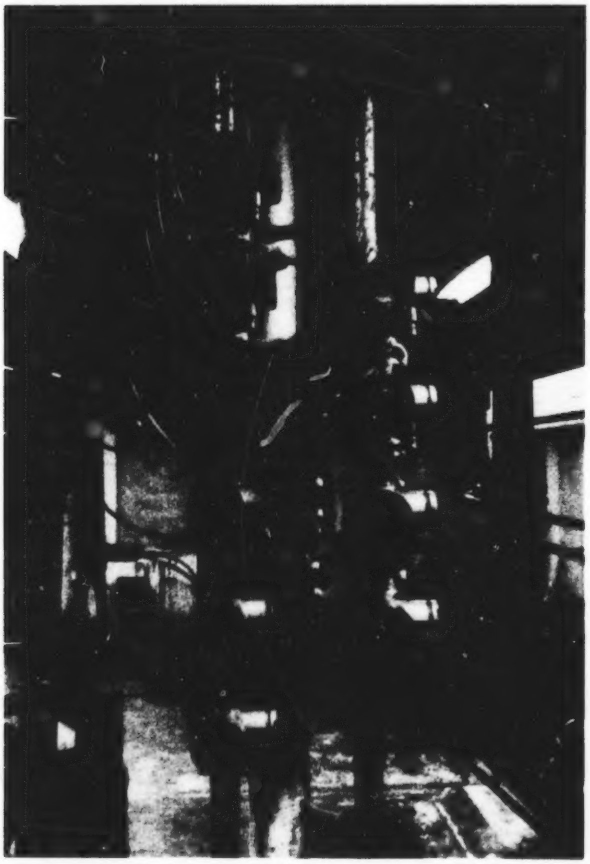
HOT WATER RECIRCULATING PUMPS
SEAWATER CIRCULATING PUMPS

SEAWATER CIRCULATING PUMPS
HEAT PUMP



HEAT PUMP CONDENSER MOTOR CONTROL PANELS

WASTE HEAT PLATE HEAT EXCHANGER



SENSORS AND
TRANSMITTERS